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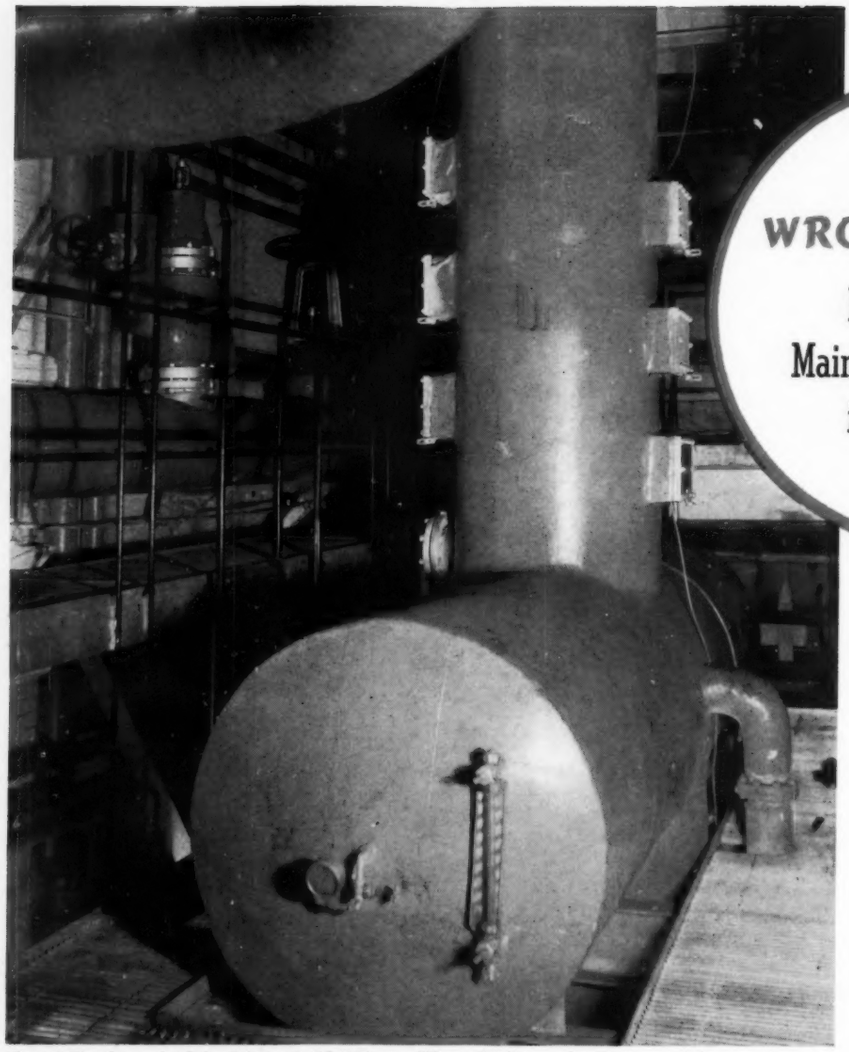
FACTORY

MANAGEMENT AND MAINTENANCE

A McGRAW-HILL PUBLICATION

JANUARY 1942

HENDERSON on Price Control

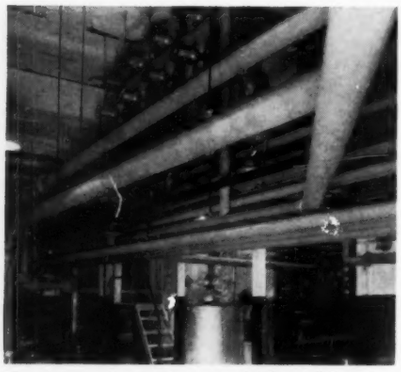


This "T" shaped tank, fabricated of Byers Wrought Iron plates, is used for condensate storage, and also to store make-up water. Almost every engineer recognizes the value of wrought iron for return lines . . . and these tanks are naturally exposed to the same service conditions. A large house water tank is also wrought iron.

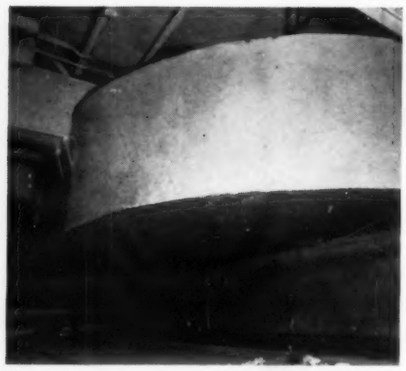
BYERS WROUGHT IRON

Helps to solve Maintenance Problems in 11 Services Here . . .

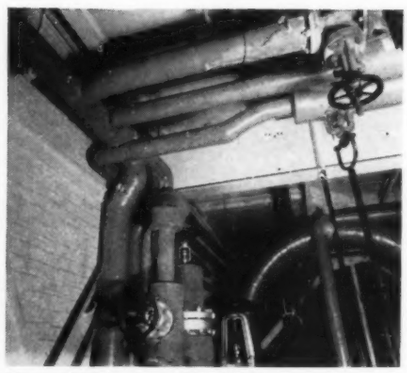
At the Crowell-Collier Publishing Company plant in Springfield, Ohio, Chief Engineer Axel Lundbye makes extensive use of wrought iron in solving maintenance problems. It has been successfully utilized in 11 applications. If you have any services where (a) corrosion, or (b) fatigue are causing premature failures of ordinary materials, by all means investigate wrought iron. Our Engineering Service Department will give you authentic service data on actual performance in similar jobs. Also ask for our Technical Bulletin, "Wrought Iron for Tank Construction." A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.



The lines shown here include cold water return lines from Air Compressor, water lines from bearing coolers, high pressure (200#) steam, and exhaust lines . . . all wrought iron.



The economizer breeching shown is made of Byers wrought iron. The material was also used in water cylinders on the printing presses, and for sucker rods on the deep well pump.



Wrought iron was installed for condensate return lines to the "T" tank above. Also, (not shown) in condensate return lines and hot and cold water lines which are buried under the floor.

Corrosion costs you more than Wrought Iron

BYERS GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

STEEL TUBULAR PRODUCTS

FACTORY
MANAGEMENT AND MAINTENANCE
A McGRAW-HILL PUBLICATION
JANUARY 1942

HENDERSON on Price Control

Fighter planes that will avenge Pearl Harbor are rolling off the assembly lines of America's aircraft plants in unprecedented and ever-increasing numbers. Bell Aircraft's Niagara Falls plant is built for mechanized assembly. Prefabricated parts from the company's Buffalo plant move in one end, finished Airacobras out the other. Dragline conveyors set the pace on the four assembly lines. Kodachrome by courtesy of Bell Aircraft Company.

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FACTORY

MANAGEMENT AND MAINTENANCE

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CURRENT efforts of brain and brawn, man and machine will determine how far today's concerns will go *tomorrow.* To manufacturers now "on their mettle" to meet the challenge of future merchandising needs, Hinde & Dauch offers the facilities of the Package Laboratory. Just as H & D's 25 mills and factories are now working full time to produce shipping boxes for hundreds of items, from shells to shoes, H & D's Package Engineers are ready to "deliver" for manufacturers seeking authoritative packaging recommendations and services.

New standards of simplicity, effectiveness, economy, practicality are continually being established as H & D Package Engineers work full time on corrugated package development. Perhaps the adaption of one or more of these corrugated achievements will save you dollars today, as well as precious time tomorrow.

These services include the study of your product, your market, your complete packaging program; the development of corrugated packages to meet the situation squarely; the preparation of packages which are more simple, more economical, more effective . . . depending upon your objective. H & D can perfect the packages you need to complete tomorrow's merchandising program so that it can be "stored" as a unit, ready to roll when business gets the signal to go ahead. Write us today. There's no obligation.

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What Can I Do?

EVER SINCE that Sunday morning when havoc swooped from the skies upon Honolulu, a new question has been churning about in millions of American minds. It is this: What can I do to help my country win this war?

This insistent question has pushed aside all matters of personal interest. From now on, individual wants and wishes must give way to the paramount needs of the nation. We all accept that. We have undertaken a huge job. Or, I should say, we have had a huge job thrust upon us. And unless we see that job through successfully it won't much matter what any of us may want.

That job is to win this war.

No longer are we trying to prepare for a war that we may get into. Today we are trying to win a war we're already in—and in up to our eyes. Nothing that any one of us now can do to help himself can get him very much if it does not also help our country to win this war.

I am sure that those who read these words will find many things to do. Some will enlist in the armed services. Some will become active in civilian defense. Some will labor to relieve distress in their home towns. Some will work with organizations set up to serve the men at the front. Each can and will find something he can do.

But this insistent question "What can I do?" goes beyond the individual and his personal service. It re-echoes through the offices and the shops of every American business concern. And what I have to say here is not directed toward individual effort. Rather is it intended for the men and women of American industry who make that industry a living part of American life. Today they are asking themselves: What can industry do? Or better still, what *must* industry do if our country is to finish the job it has started?

Those of us who work in and with American industry have one supreme obligation. We may feel very patriotic; we may be willing to serve "in any capacity;" we may be willing to sacrifice . . . if necessary. But if we fail to meet that one obligation, we shall fail our country in its time of need.

THAT SUPREME OBLIGATION IS AN HONEST DAY'S WORK, EVERY DAY, FROM EVERY MAN, EVERY WOMAN, EVERY MACHINE. . . .

IT IS AS SIMPLE AS THAT!

And that goes for all of us, whether we are engaged in civilian production or working directly on the weapons of war. American victory can be won only through the productivity of American industry.

Efficiency in production is not the responsibility of a few. It can be achieved only as we all put to useful purpose every minute of our time, every ounce of our energy, and every pound of our materials.

This responsibility of industry is the more vital because of what has happened to the business of making war. There was a time when success in war was chiefly a matter of well-trained, well-disciplined armies and competent leaders—when men were everything. In those days, military strength was a matter of strong battalions and able generals. Both still are vital. But today military might is essentially mechanical might. Modern war is an industry just as much as a factory or a railroad. In the first World War, mechanical equipment was relatively simple and limited. But today the special equipment of war and the expert skill needed to use it spell the difference between victory and defeat.

We Americans are not expert war-makers. That is why we must expect to suffer grievous losses before we can win substantial gains. We do not have military training and experience ready to hand when we need them. Neither do we have, ready for action, enough of the machines that are so essential to modern warfare.

So, when it becomes necessary to fight for our lives, we must start from scratch. And today, after a year's effort, we still are not ready to trade blow for blow with enemies who for years have schooled their leaders, trained and disciplined their people, and organized their industries to make war. We shall need more time to develop our strength. And while we are doing that, we must expect reverses.

But there is a brighter side to all this. For it follows that if we are granted this all-important time, the change in the method of warfare is right down our alley. The greater importance of mechanized equipment plays straight into the hand of the world's greatest industrial nation . . . if there is one thing America does know, it is industrial production! Our industries know how to produce. They have the skilled manpower. They have the organized facilities. Beyond any doubt, we can produce all that we need to win the victory that we *must* win—if only we are given the time.

THE FIRST RESPONSIBILITY OF THE ARMED FORCES IS TO GAIN THAT TIME FOR US.

THE FIRST RESPONSIBILITY OF INDUSTRY IS TO USE TO THE FULL EVERY SECOND OF THAT TIME IN PRODUCING THE WEAPONS

THE ARMED FORCES NEED TO WIN THE ULTIMATE VICTORY. INDUSTRIAL PRODUCTION IS THE KEY TO VICTORY. BUT IT MUST BE BIGGER PRODUCTION AND FASTER PRODUCTION THAN WE EVER HAVE KNOWN.

Heretofore American industry has worked to produce more of those things which make our lives more enjoyable. Today it must divert much of its energy from the products of peace to the weapons of war.

This change sets up a new yardstick of industrial performance. In time of peace we measure production efficiency in terms of money saved. From now on, we must measure efficiency chiefly in terms of time saved. For the plane, the tank, the gun, or the ship that is ready when it is needed to win a victory, is worth a million times more than the one that is delivered too late to avert a defeat.

Everyone knows how short we are of some materials and machines. But our most tragic shortage is the shortage of time. So whatever we may waste in the days ahead—and unhappily we are bound to waste plenty—let us never forget that the most deadly waste of all is the waste of time.

Time wasted never can be replaced. No one ever has discovered a substitute for time. If we would avoid the waste of this irreplaceable ingredient of victory, we must use every minute of it effectively—*while we still have it.*

That goes for us all. It goes for the man or the woman at the bench, at the desk, at the counter, in the field, or in the executive office. It goes for the politician as well as for the business man. It goes for the humblest and the most powerful. A nation at war cannot carry deadheads. It cannot spare a square foot for any one who will not pull his weight.

In this war, nothing short of complete victory can save the liberties of us all, rich and poor, employer and employee, haves and have-nots alike. The price of that victory is the labor, the loyalty, and the devotion of every last one of us. Winston Churchill said it well for the British people. You know how he said it. I need not repeat it.

All this imposes upon American industry, its owners, its managers, and its workers, the gravest responsibility they ever have assumed. If our country is to survive as a free nation, American industry must rise to that responsibility. If our country should fall, it would fall because American industry fell short of the need. It would be another case of "too little and too late".

This grave responsibility calls for the keenest management industry ever has known. It calls for unremitting research to make the most of our resources. It calls for the reduction of waste to a record minimum: that goes for waste of time, labor, and material. It calls for keeping our machinery working as near to full capacity as we can contrive. It calls for the highest rates of unit production we ever have known. That will mean skillful coordination by management and the most intelligent cooperation that the men in the shops can give. It calls for inventive ingenuity to match that of a nation which has produced some of the world's outstanding technical genius. For this is a war of technical proficiency.

But above all, it calls for a new devotion to the day's work. For so long as we are at war, the day's work will determine our country's security.

Whatever may be our material resources and our technical skill, however resourceful our management, however broad the scale of our effort, industry cannot measure up to its prodigious responsibility if any of us shirk the day's work. Right there is where we find the one thing we *all* can do—the one thing that is within the power of each of us.

THAT ONE THING IS SIMPLY TO DELIVER AN HONEST DAY'S WORK WHEREVER WE ARE CALLED TO SERVE. HONEST WORK WILL WIN THIS WAR. LOAFING WILL LOSE IT. THE SHOWDOWN WILL BE WHETHER HITLER CAN DRIVE HIS PEOPLE TO WORK HARDER THAN WE ARE WILLING TO WORK. THERE IS NO ONE TO DRIVE US. WE MUST DRIVE OURSELVES!

Is that so much to ask? It is all our country asks of us, the men of industry. It is all that the men who must work the guns and tanks in the field ask of us. It is all that the men who work our ships and our planes ask of us. "Give us the planes, the guns, the ships, the tanks, and all the rest of our tools," they tell us, "and we'll give you the victory that means so much to us all. But, in the name of that victory, give them to us quickly—QUICKLY—QUICKLY!"

Is that, I repeat, too much to ask of us?

* * * *

To help American industry achieve ever-higher standards of efficiency has been the traditional mission of McGraw-Hill for three-quarters of a century. Normally that effort has been directed toward higher efficiency in the business of peace. But, as in the first World War, twenty-five years ago, it now is directed toward efficiency in the business of war and in every department of American effort that can contribute, directly or indirectly, to the achievement of victory.

And to that mission, I here pledge every resource of this company, its publications, its books, its staff, and every service it is qualified by experience and training to render to American industry, now enlisted in our common cause.

That is what we of McGraw-Hill can do. And that is what we *shall* do to our utmost.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

This message is appearing in all McGraw-Hill industrial and business publications, reaching over a million readers.

FACTORY
MANAGEMENT AND MAINTENANCE
L · C · MORROW · EDITOR

Now for Some Real Production

"Give us more production for the armed forces" is the cry that will come again and again to industrial plant management from Washington. Rightfully so; literally, the balance of world power lies in American factories. American industrial management, within the limits imposed by the scarcity of materials and man-power, now has an opportunity for all-out production such as it has never visualized since the birth of interchangeable manufacture.

There are many ways in which industry can respond. Here are the five principal ones:

Plants not so engaged can take on the manufacture of essential products, thus putting more machines to work.

More plants can go on multiple-shift operation to keep their machines at work all the time.

All plants can improve their methods, in the interest of saving our most precious possessions—time and materials.

All plants can train both supervisors and operators, to insure adequate working forces even though more men go into the Army and Navy.

All plants can keep their working forces at work by looking after their health, providing safe working conditions, and protecting the plant from sabotage and other destructive forces.

One of these five steps should be singled out for especial emphasis. It is *improvement of methods*. Unless those methods are used that will keep machines actually producing as close as possible to 100 percent of the time, all the other steps will be nullified to some extent. There is never anything to be gained by letting a tool cut air.

When machines are plentiful, methods should look toward the operation of more than one machine by each operator. When the operator must handle one machine only, then indeed must that brand of ingenuity be used which will minimize the idle time of the machine while the operator carries, loads, and unloads work.

It is much less costly in time as well as dollars to use more efficiently what we have than it is to provide additional capacity. We may have to do both, because this is a big war, and big production will have to be had. But there is no excuse for not getting the most out of existing equipment.

Up to now, except in relatively few instances, the nation has not had the most out of its productive forces and equipment. Because of the touchy labor situation, management has refrained from setting standards that could get the most out of man and machine. Because of technological unemployment, organized labor has resisted mechanization and efficiency.

But now things will be different. They *must* be different, because management and labor face the same problem together. They just can't get away from the fact that they must produce in unprecedented volume.

L C Morrow

Our Fight Against

By LEON HENDERSON

OPA chief asks management's support in struggle to preserve stable economy and so hasten defeat of the Axis. Denying "reform" aims, Henderson explains price control objectives and policies. How does his program relate to increased taxes? Higher unit costs? Selling costs? Machinery prices? Herewith his views in a signed message to industry

MODERN WARS are more than ever before economic contests in which the margin of victory may well be dependent upon a smoothly running industrial system. Under such circumstances, adequate price control to prevent inflationary price movements becomes a weapon no less important than guns and tanks and aircraft.

We cannot afford to deceive ourselves about the dangers of inflation; it is a threat, an immediately present threat, to our security, to our democracy, to our survival as a great economic power. In every major war period which this country has experienced, the level of wholesale prices has more than doubled. As wages, prices, costs, rents, and charges of all kinds join the upward whirl, the whole economic system is subjected to increasingly dangerous stresses and strains, and permanent scars may be left on the system unless the inflationary spiral can be controlled now.

The objective of the Office of Price Administration is to prevent unwarranted price increases; its program will cover all kinds of commodities and affect every manufacturer. The support of every company will be needed in our task of overcoming the imminent advance of the inflationary spiral which is threatening us all.

Specifically, OPA intends to help industry control its costs by insuring that the prices of industrial equipment, repair parts, subassemblies, and fabricated materials are kept within reasonable limits. This will permit orderly planning of production by factory management. Management can effectively assist this program by

Price control . . . becomes a weapon
no less important than tanks and guns and aircraft

HIGH PRICES

Press Association, Inc.

One of Washington's leading economic trouble-shooters is Leon Henderson. The key job of Price Administrator fell naturally to his lot after experience as SEC Commissioner, Executive Secretary of the TNEC, Economic Advisor to the Senate Committee on Manufactures, and Research Director of NRA. Previously he had taught economics at the University of Pennsylvania. In 1917, Henderson entered the Ordnance Department as a private and was mustered out as a captain

keeping itself informed of price regulations on various products, and by observing and reporting violations.

The prevention of price inflation is a cooperative venture in which the owners and managers of factories have a very great and a very direct stake. Increases in the prices of machinery and equipment contribute materially to the inflationary spiral, because all price advances are contagious, because each individual advance adds to the steadily rising pyramid of prices, and because the prices of machinery by affecting costs affect the price of the product directly.

This article will therefore attempt to describe the problems and basic policies of the Industrial and Agricultural Machinery Section of the Office of Price Administration. These policies have not been spun out in an ivory tower, rather, they have been worked out painfully over a period of months in dealing with actual situations in various industries, and thus represent an attempt to generalize a large body of decisions made in specific situations. They are the product of experience with many firms, and of the collective wisdom of the men who have been dealing with these problems. We do not regard them as iron-bound rules of procedure at all; it is recognized that we must remain flexible enough to modify policies when necessary to adapt them to the particular situation.

I have yet to talk to a businessman who did not concur in our major objective of preventing a price inflation. This goal must be attained in a manner consistent with the general objectives of the entire defense program, which means that this office must not stand in the way of the production goods needed, plant expansion necessary, or curtailment of production of non-essential goods.

Like Quick Freezing

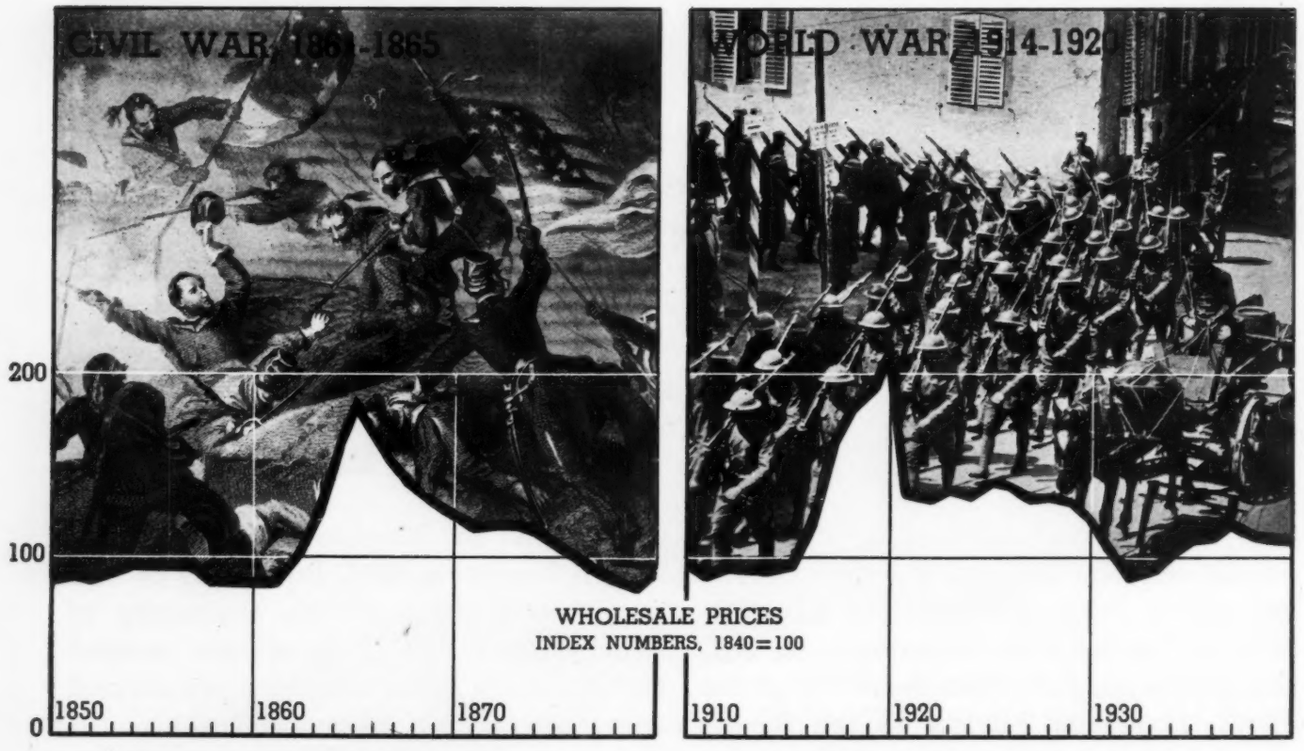
OPA is not a reform agency. Its objectives are to preserve our competitive economy by a process analogous to quick freezing, so that when the emergency ends it will function as before. We are not primarily concerned with what is or is not fair trade and all the connotations thereof, as was the NRA, for example.

The first question to consider in stabilizing prices of any industry is: Where should we start? Except where inflationary price movements have already occurred, prices as of some recent date or period can be taken as our norm. Wherever marked price increases have occurred, we must consider such factors as profit levels, the level of output, and the relation of cost to prices. Similarly, when price advances are proposed, they can be justified only by data which demonstrate that they are necessary.

We are aware that some injustices are bound to be done to some firms by stabilizing prices as of a given date. We will make subsequent adjustments for firms that can establish that they experience undue hardship. In reviewing such requests for adjustments, we must decide what are valid reasons for permitting price advances.

We are of the opinion that higher corporate income taxes are not a justification for a plea of special hardship and for the granting of price increases. It is a universally recognized principle, as any lawyer or accountant or economist will tell you, that income taxes are not costs in any real sense of the word; they are a levy upon profits, so that if you make no profit you pay no tax. Ordinarily it would

OTHER WARS HAVE ALWAYS DOUBLED PRICES



not be possible for firms to pass on the tax to their buyers by charging higher prices, because higher prices would curtail volume of sales. However, in a wartime boom such as the present one, it may be possible to pass on the tax to the buyers, because of the unusual demand situation. This office feels that it should not countenance a price strategy designed to change the incidence of taxation by advancing prices to take full advantage of what the traffic will bear. Paying that tax ought to be the contribution of each company to America's war effort.

We believe that the only cost increase that should be considered a justification for price advances is an actually realized increase in per-unit cost resulting from increases in wage rates and material prices. These increases must be actual and not anticipated increases. Further, evidence must be supplied to show that a wage-rate increase which has taken place has resulted in higher cost per unit. As every firm knows, wage rates may increase 10 percent without a corresponding increase in per-unit cost. It does not follow that every demonstrated increase in cost from these causes will mean that the office will approve price increases; on the contrary, the manufacturer will be expected to absorb some of the increased production cost.

OPA's objectives are to preserve our competitive economy by a process analogous to quick freezing, so that when the emergency ends it will function as before.—*Henderson*

Another limiting factor is that only those increases in selling and administrative cost per unit that can actually be demonstrated are allowable justification for price advance. Mere application of the same percentage to a higher list price does not constitute evidence that selling and administrative costs have increased; in some instances selling costs may decline per unit because of the unusual demand situation, and it might be logical to reduce dealers' commissions for that reason.

A related question is whether, on the assumption that a certain price increase has been granted, this percentage should be applied uniformly over all of the items in a multiple-product firm. Unless it is clear that some useful purpose is served, we doubt the wisdom of disrupting normal competitive adjustments within a product line by insisting on uniform percentage increases. In general, we are interested in the over-all profit picture of a firm rather than the profit margins of individual products. Our basic principle is that, as long as the corporation's over-all profit picture is satisfactory, price advances should not be granted for particular items unless their cost has advanced to the point where individual product direct costs exceed the existing prices.

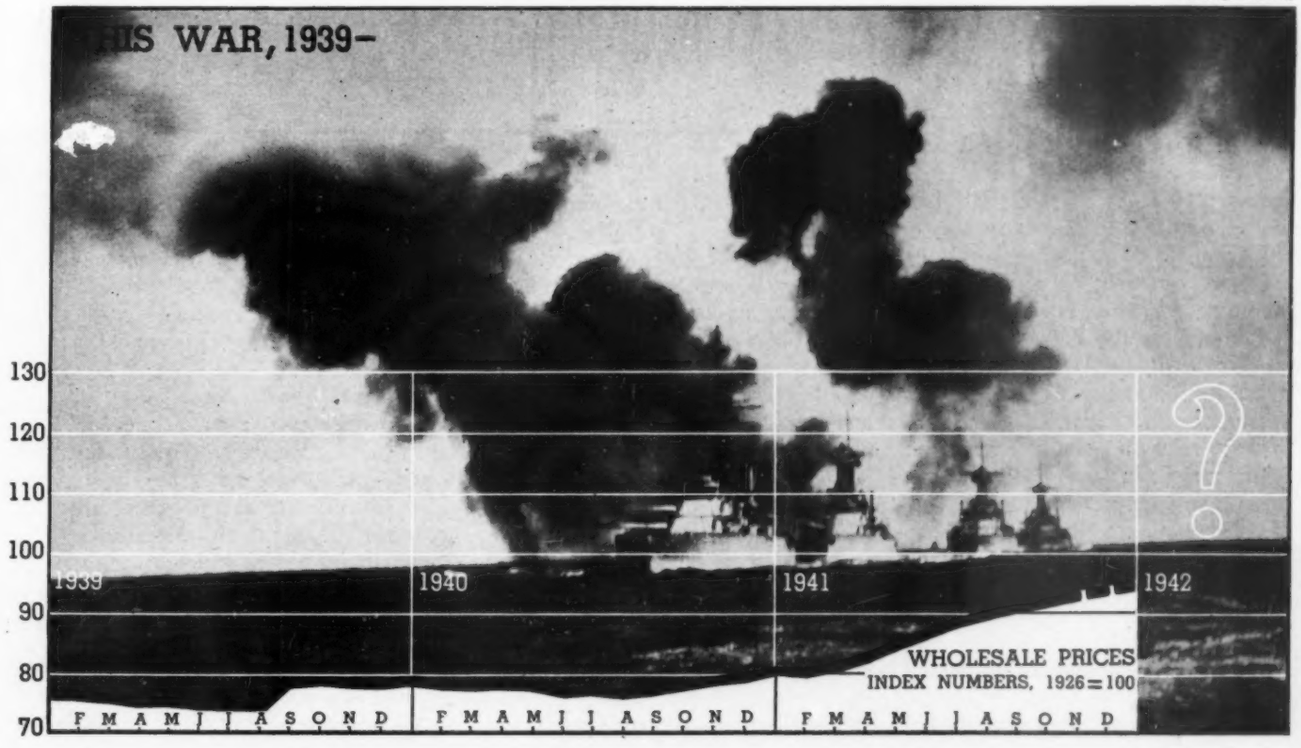
There are, however, a number of special situations requiring administration of individual product-price adjustments. These should be looked upon as exceptions to the general policy.

First, the policy should be modified to discourage shifts from more important to less important products within the firm's products line.

Second, it seems desirable that high-volume, standardized, stripped model items be advanced as little as possible,

CAN WE HOLD PRICES DOWN THIS TIME?

Ewing Galloway



even though this requires greater increases in deluxe models. This minimizes the customers' adverse reaction by restricting the number of people affected, and works toward what we feel is the basic solution for civilian scarcities—that is, increasing the relative consumption of low-cost standardized models.

Third, we feel in general that prices on repair parts should be advanced less than on new equipment. In times of emergency, scarce materials should be used first to keep existing equipment operating. The assurance of continued production resulting from the preferred priority status which repair parts enjoy should temper price advances. Also, the profit margins on repair parts are fairly generous; therefore absorption of cost increases should be greater than elsewhere. Again, repair parts affect a large total number of customers, and keeping prices stable would minimize adverse consumer reaction to price advances.

Most industries today are taking orders for delivery at some future time, and in many cases at quite a distant time. The problem of "forward pricing" such equipment is one of the most difficult which we face. Producers are presented with the problem of probable future increases in labor and material costs, transportation costs, and excise taxes, and they demand some kind of protection in quoting prices for future delivery.

Escalator Clauses

The escalator clause is a popular device; it is simple, automatic, and easy to administer. It is in wide use at present, in various forms, and therefore merits detailed consideration.

By providing automatic increases in prices to correspond to cost increases, the escalator clause guarantees the operation of the inflationary spiral which we all fear. It does more than that—it accelerates the spiral; it does this because of the manufacturing "lag" in wage rates and material costs. In other words, in a period of rising prices, the rates prevailing at the time of delivery of a machine do not reflect the actual amount paid for labor and materials incorporated in that machine because of the lapse of time between purchases of materials and use of labor, and the completion and sale of the machine. Also, costs per unit of product do not usually go up as fast as wage rates and material prices. Thus prices rise faster than costs increase.

Moreover, the escalator clause may remove the incentive to economize and may instead offer an incentive to pad production costs. If national indexes are used to determine whether costs have risen, we might in effect be granting unnecessary bonuses to individual producers who have experienced no cost increases although costs in that industry as a whole may have risen.

Finally, escalator clauses give preference to a firm that has forward pricing problems. Unless we wish to adjust ceilings for current delivery material upward every day as wage rates and material prices rise, then we ought not to permit escalation for those manufacturing concerns that do have forward pricing problems.

We feel strongly, therefore, that escalator clauses are not a solution for the problem of forward prices, but that they are on the contrary distinctly inflationary in character.

The alternative is for OPA to make necessary adjustments on the ceiling, on the bases of cost prices, profit levels, and other relevant considerations. The manufacturer would be expected to stay with the price ceiling as long as possible, then present his case to OPA when he had data to show that a price increase was justifiable.

This method is flexible, and takes into account many factors such as the profits of a firm, the degree of subcontracting and its effect on costs, the amount of cost absorption that should be expected, cost prices, the special problems of the individual firm, etc. This appears to be the only solution that will protect both buyers and sellers, prevent an inflationary spiral, and tie in with the larger objectives of the war program.

The last topic for consideration is the problem of specially designed or special-order equipment, which is very important in certain industries. The problems involved are complex, they differ from industry to industry, and from machine to machine. Consequently, no universally applicable solution for price administration is to be expected, and cases will have to be studied individually.

Price administration in the machinery field is particularly difficult, due to the diversity of products, the technical complexities of the various machines, the large percentage of custom-built equipment, and the lack of previous study and research on the industry. However, the strategic importance of machinery to the national defense makes imperative a successful job of price administration in this field.

Putting the brakes on inflation is a task in which every manufacturer and all factory management men must assume their share of responsibility. The achievement of our major objective of winning the war necessitates an economic system which is operating at full productive capacity.

It is our desire to preserve the system of private enterprise we now have so that it will be ready, at the close of the emergency, to apply its resources to the tasks of reconstruction.

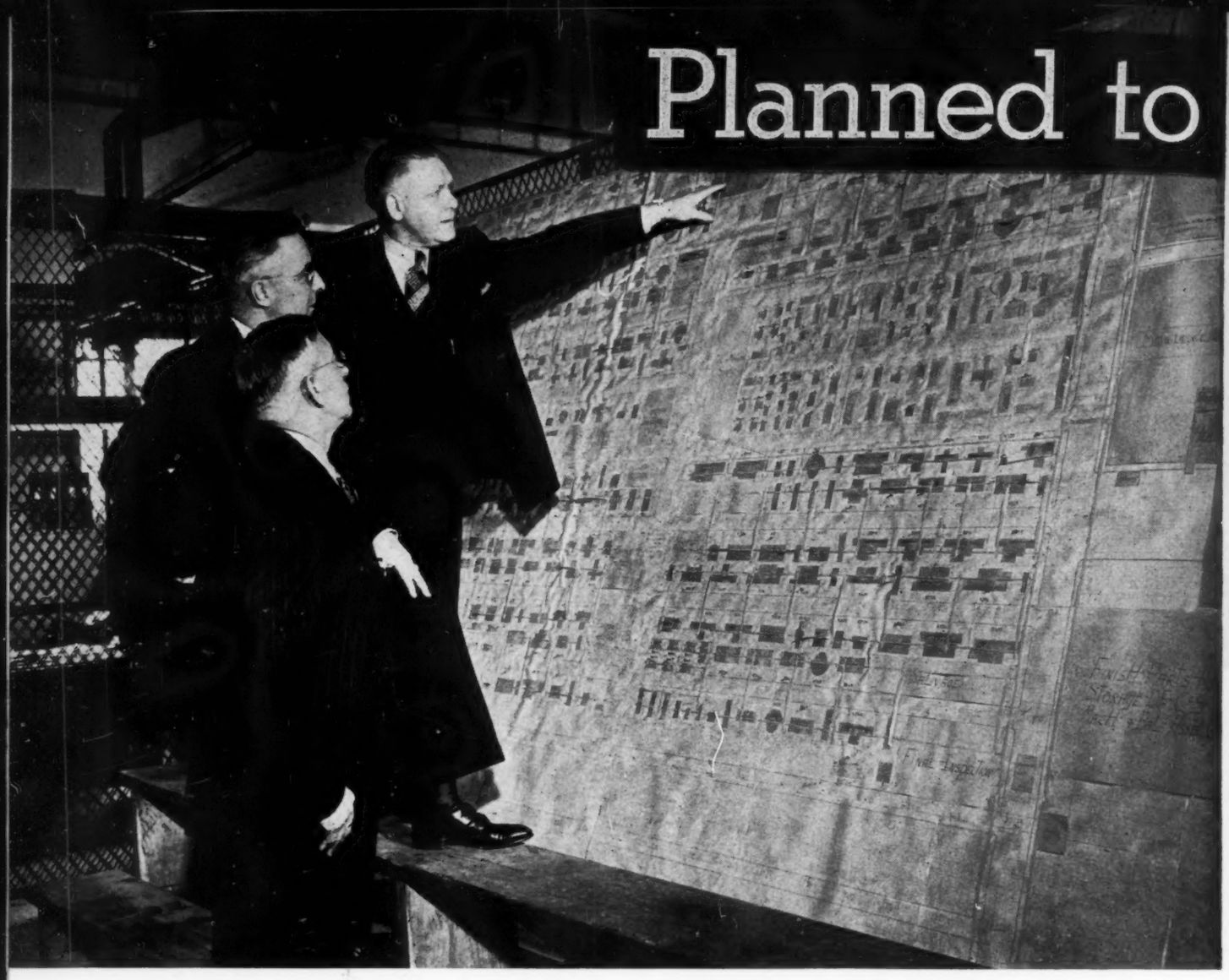
MANAGEMENT'S STAKE IN PRICE CONTROL

OPA intends to help industry control its costs by insuring that the prices of industrial equipment, repair parts, subassemblies, and fabricated materials are kept within reasonable limits . . . Management can effectively assist this program by keeping itself informed of price regulations, and by observing and reporting violations. Prevention of inflation is a cooperative venture in which owners and managers of factories have a very great stake.—*Henderson*

Photograph by courtesy of Vultee Aircraft, Inc.

BIRDSBORO

Planned to



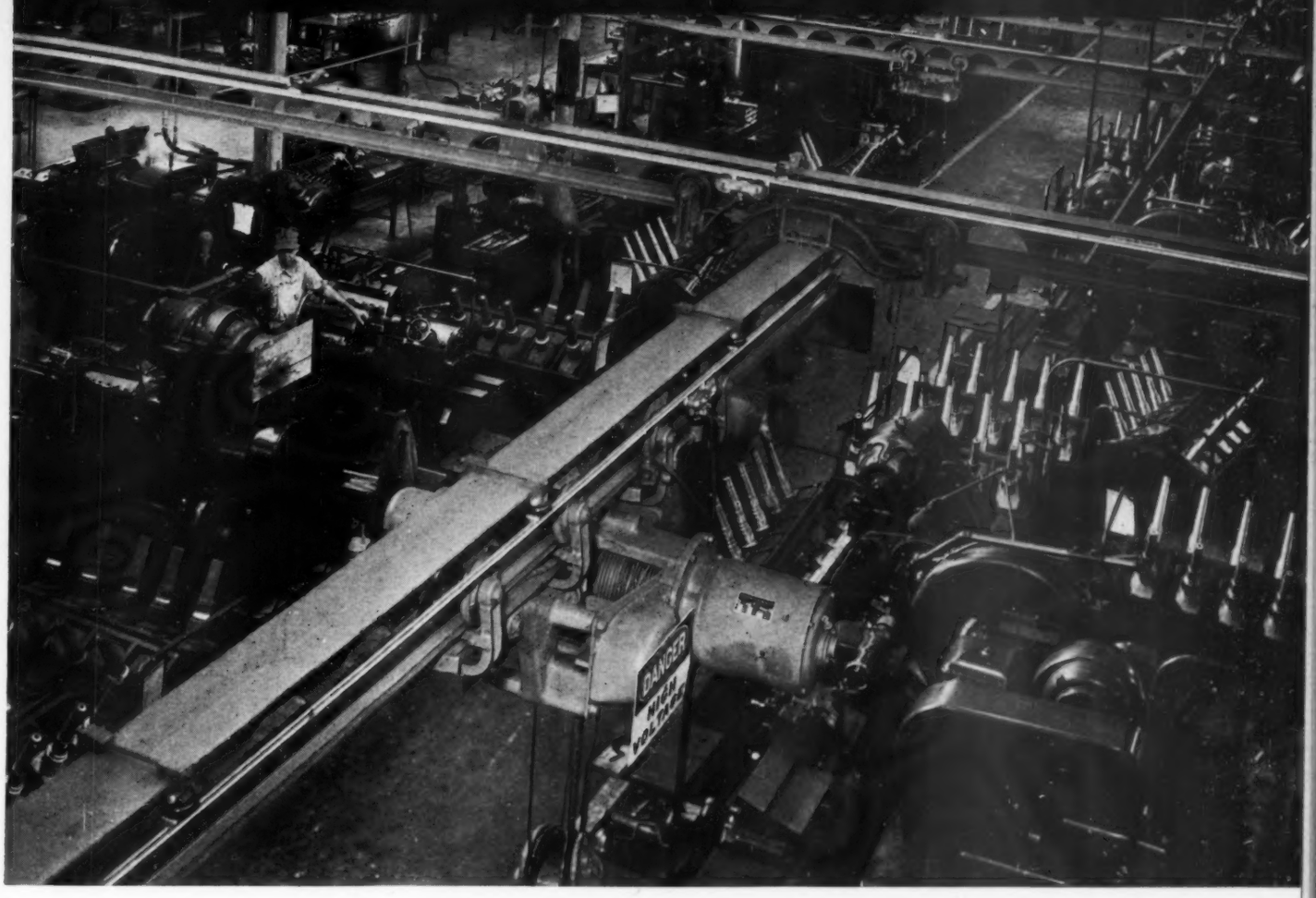
"Answer to a production man's prayer" is what Ohio Crankshaft people are calling their new plant. Designed to make a single product. Laid out for maximum output, minimum effort. Eight tries were made before final layout was agreed upon (above, top to bottom) by author, Factory Manager J. F. McCarthy, and General Foreman M. C. Kohler. It was based on observation that a man able to tend three machines would have to walk 72 feet if units were placed side by side, only 14 feet if laid out in triangular fashion, one on one side, two on other side, of aisle. Across the page, a bird's-eye view of line where front sections are machined. Every move by special dolly, every lift by crane and hoist

HARVEY W. SELLERS,

STRAIGHT-LINE LAYOUT and modern handling equipment have made possible a remarkable production record of aviation engine crankshafts, which Ohio Crankshaft is machining for Wright Aeronautical Corporation at Lockland, Ohio. Just a year old, this $4,500,000 defense plant has already reached 50 percent of maximum production, and by March 1, 1942, output will be 100 percent. At that time the volume will run into a four-figure total. Already on order are machine tools that will enable the company to boost production an additional 40 percent by fall.

The plant is regarded as the answer to a "production man's prayer." Its entire layout has been arranged for this very precise production problem in which there are 607 distinct machining and inspection operations. The plant is equipped with 314 new

Speed a War Product



Production Manager, Ohio Crankshaft, Inc., Cleveland

machines valued at more than $3,000,000. Sixty percent of the work is precision grinding. How precise is revealed by the fact that 100 dimensions on the shaft are held to limits of less than 0.001 inch, and the bearing surfaces of the crankshaft have a finished smoothness polished to 4 millionths of an inch.

The sole product of the plant is a 206-lb. two-throw crankshaft specified for 1,700-hp. double-bank radial motors. The shaft is designated as 2600-B and goes into Wright 14-cylinder Cyclone engines used for Army medium bombers and Navy dive bombers.

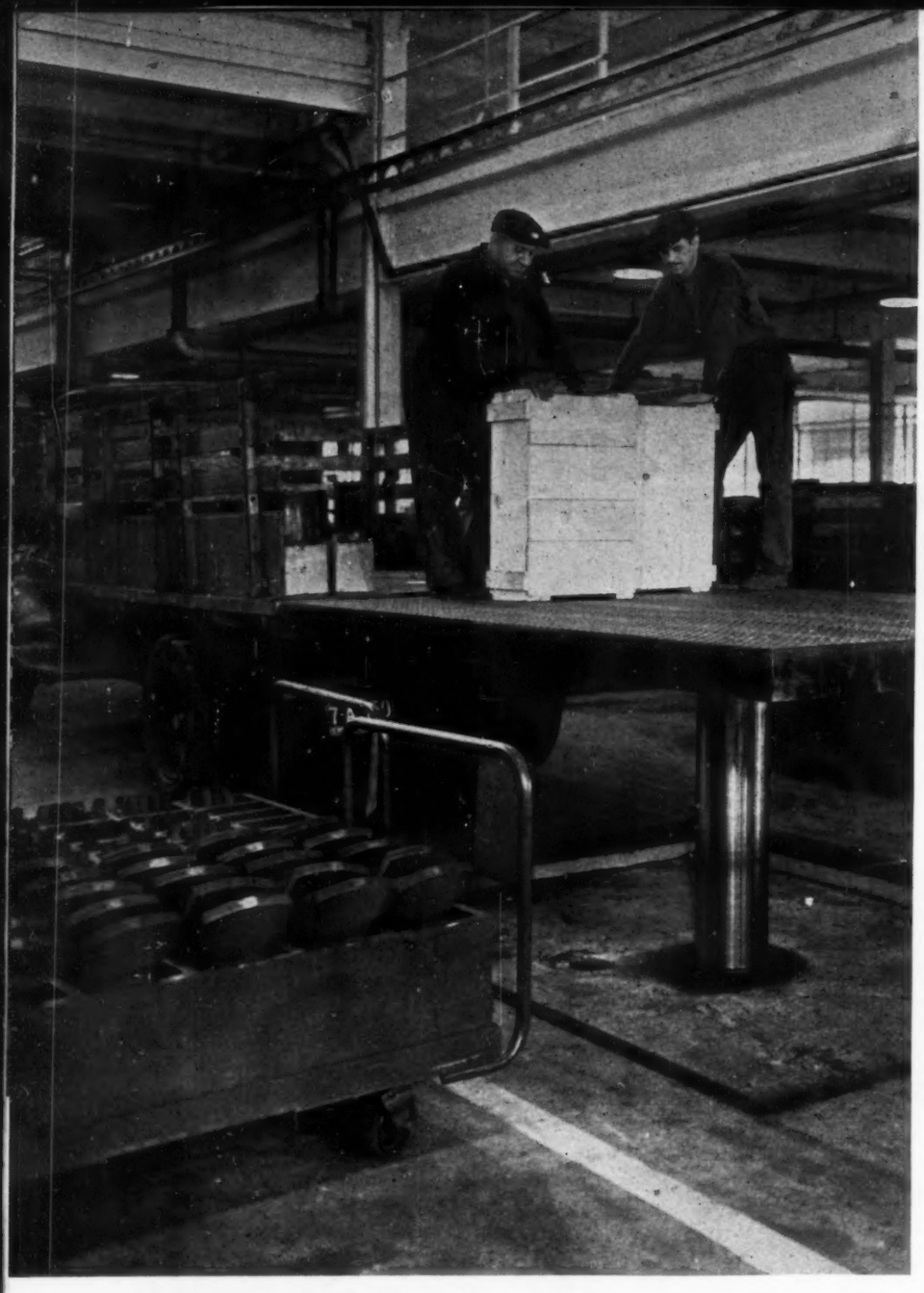
With 220,000 square feet of floor space, the 330 x 520-ft. one-story monitor-type plant provided an excellent opportunity for machining line arrangement that simplified passage of the parts from machine to machine. Prior to completion, Ohio Crankshaft's factory and production managers spent several weeks at Paterson, N. J., studying Wright crankshaft technique. From this study, together with 20 years of crankshaft manufacturing experience, came the general set-up of the new unit.

Laid Out to Scale

Eight trial layouts were made before the present arrangement was decided upon. To a scale of ¼ inch to the foot, machine templet cutouts were mounted into position on a board 8 x 10 feet in size. Large-headed pins were inserted to indicate that a certain machine had arrived. Varicolored paper designated departments through the plant. Blue paper cutouts showed position of the machines; pink, the toolroom, cutter grinding departments, and general offices; yellow, inspection offices and various storage centers. Overhead cranes were revealed by pink strips following the machining lines.

In the preliminary study of possible layouts it was early ascertained that an operator, able to handle three machines, would have to walk a distance of 72 feet to tend these three units if placed side by side. But, if the machines were set in triangular fashion with one located just across the machining line aisle, the distance the operator must travel was reduced to 14 feet. The final plant layout was therefore based on this observation.

This triangular arrangement of machines has also been the basis for development of the company's efficiency grouping. Simply, this is a division of a machining line according to groups in which there may be from 14 to 20 operators supervised by a group leader. In this layout two men



Trucks drive right into the Ohio Crankshaft plant to unload the rough forgings which form the great bulk of the raw materials used in the machining of this vital war product. Here, one of four 5-ton hydraulic platform lifts that can be elevated to floor height of any truck

can operate four to six machines efficiently. Reports of the output of each group are studied and accumulated daily. Because of this the production manager knows the efficiency of the plant by groups not later than 2 p.m. of the following day. These reports enable us to detect any irregularity that may be holding up production.

Efficiency reports reveal actual performance as compared with a standard unit-hour basis predetermined from actual time studies. The productive operators participate in a weekly bonus paid on all production exceeding this standard. Group leaders, foremen, and general foremen also participate in this plan. It has a remarkable effect in maintaining a steady flow of material down the line.

Down Machine Lines

There are three major machining lines down which the three main parts of the crankshaft pass. These parts are the center section, the rear and counterweight section, and the front section. The fourth department is for final assembly and inspection.

Near the head of each machining line is located rough stores. Forgings are received from the vendors and are checked in by inspectors from Wright Aeronautical Corporation as well as the Ohio Crankshaft accounting department, which maintains a perpetual and daily inventory of stock on hand. The forgings are stored and released for machining on orders from the production control department.

Release of parts to respective machining departments by production control follows a regular schedule based on the number of working days in a given month. From this is established the required daily output.

The center section weighing 65 pounds rough enters the line and moves straight ahead through 18 operations to heat-treating. From there it goes on to the end of the line, after a total of 135 machining and inspection operations have reduced its weight to 26 pounds. As it moves down the line, the part is conveyed in its special dolly from which it is lifted by crane for placement in a machine.

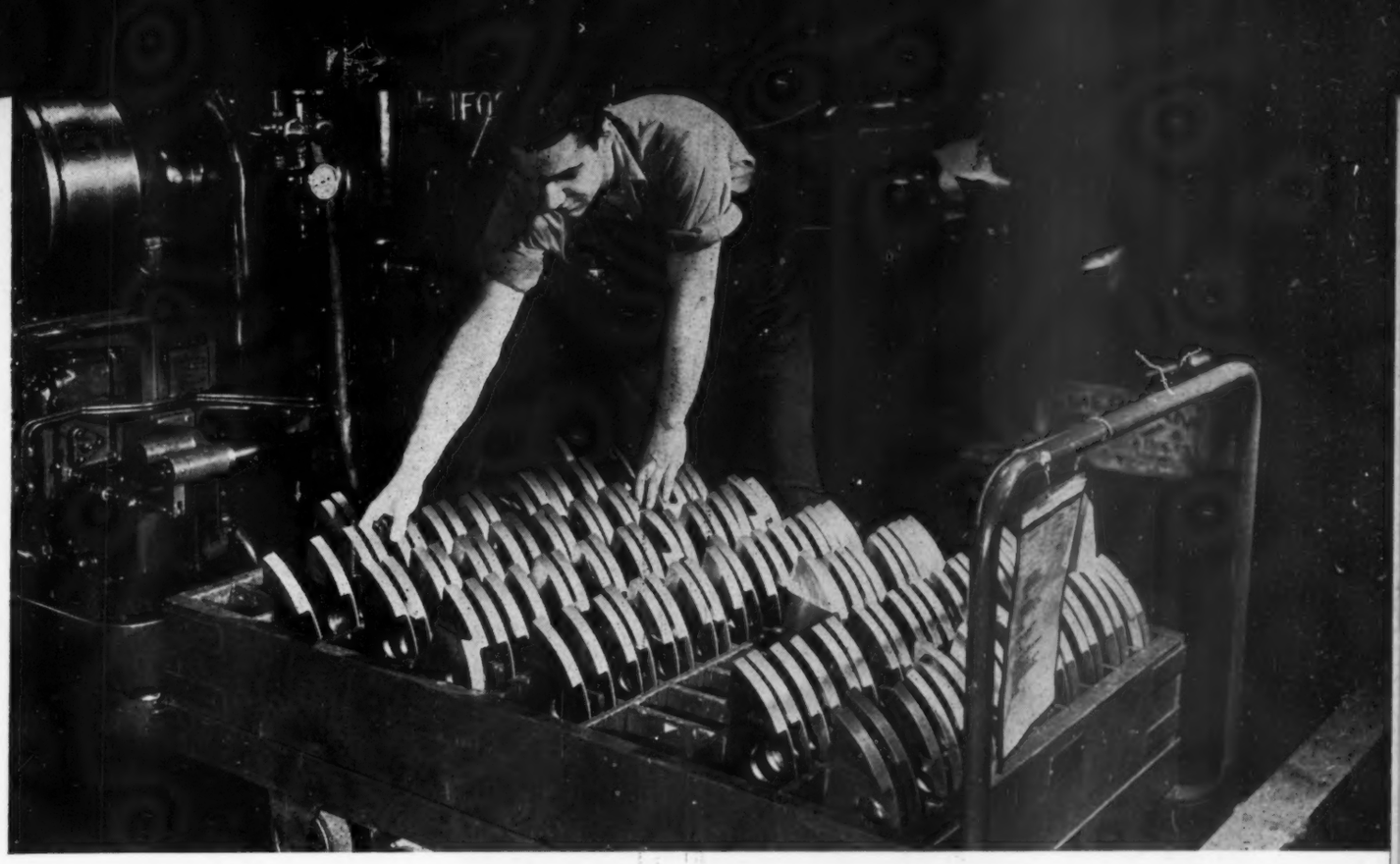
As the Crow Flies

Course of the rear and the counterweight sections is generally the same. The rough rear forging experiences 240 distinct operations which cut down its 85 pounds to 46 pounds finished. This line extends to mid-center of the plant and turns, coming back up another line along the next aisle. Closely tied into this operation is that of the counterweights which involve some 50 distinct steps. Handling of these pieces is done by hand. They are light enough for manual movement in and out of the machines and dollies.

The front section enters its machining line and follows a "crow's flight" course through 70 operations to the end of its line, at which point it is ready for final assembly. Weighing 118 pounds rough, it finishes at 52 pounds. Use of overhead cranes in this line is imperative.

Parts completed and inspected in the three major machining lines are sent to finished stores from which they are released to final assembly in multiples of five assemblies. This has been found by experience to be the most efficient way of sending parts into final assembly and inspection stage.

Government regulations prevent reporting on time consumed for these various handlings. It can be said that short cuts have been developed which steadily shorten the time a given part stays in a machining line. One drilling operation that formerly took more than 2½ hours has been reduced to 47 minutes through more efficient ar-



Specially designed floor trucks—this one holds 120 counterweight sections—are used to make all moves

rangement of drilling tools. There are other similar improvements.

Materials handling throughout the plant is facilitated by two principal methods—hand push trucks and overhead cranes.

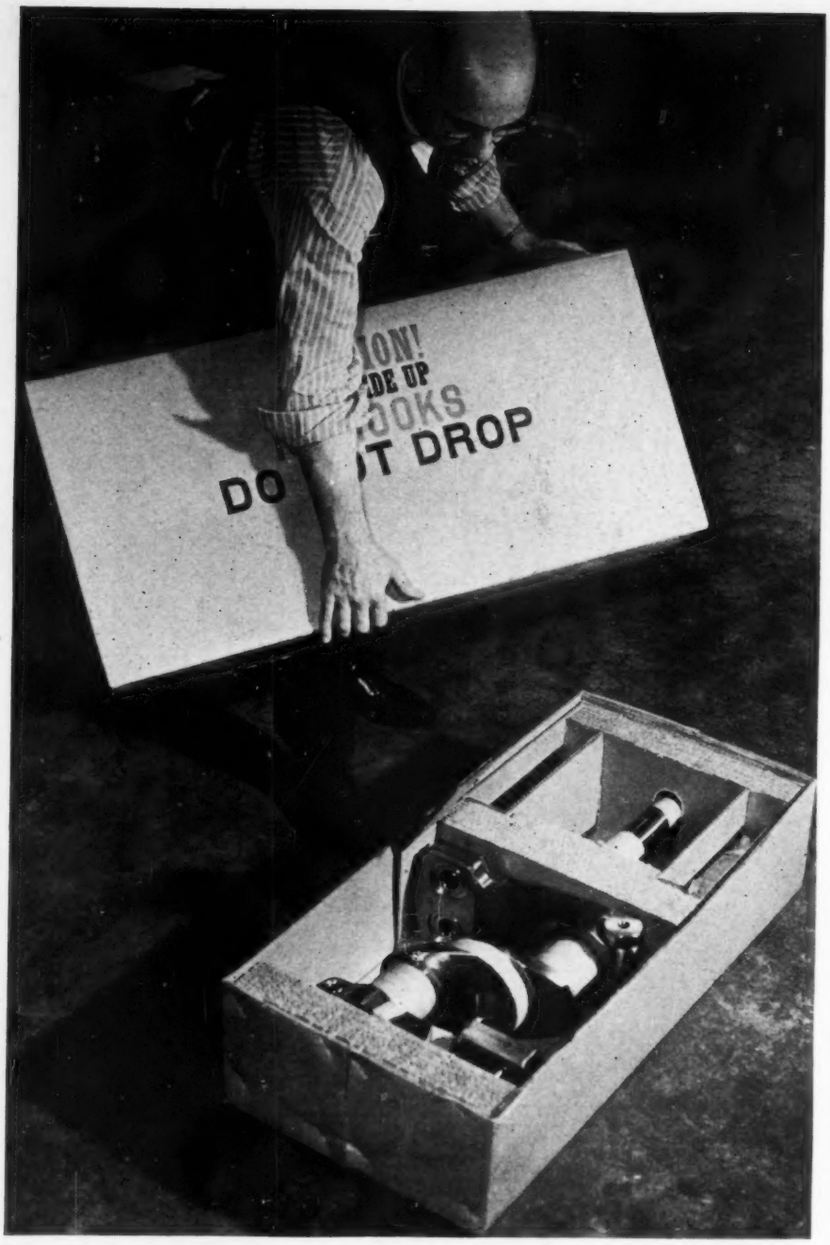
There are 675 four-wheeled trucks with over-all dimensions of 36 x 56 inches and a load limit of two tons. They are rubber-tired, painted gray, have two swivel wheels at the handle end and a U-handle formed of 1¼-in. pipe. The cradles can be removed, converting the trucks into flat beds. Trucks have been specially built for these operations.

The cradles are designed in five styles, fitting them to a certain machining section. Of heavy wooden construction, each contains compartments into which rough and finished parts can be placed. A truck starting with rough forgings follows these pieces down the line and conveys them into finished stores.

To Final Assembly

Capacity varies. The center-section truck holds 15 pieces; rear-section, 30 pieces; counterweight, 120 pieces; front-section, 10; and machine-balancing-assembly, 15 or the equivalent of 5 complete crankshafts. This latter truck is used to convey the three finished parts of the shaft into final assembly and inspection. It has a cradle for the long front section, a well for the center, and a V-support for the end section. Holes for clamp bolts are located on the right side, while the brass plates which fasten to

Machine balancing assembly truck, loaded for final assembly, carries (left to right) front, center, and rear sections of five crankshafts



Corrugated container with finished crankshaft packed and ready to be shipped to Wright Aeronautical Corporation's plant at Lockland, Ohio. Use of this box saves 50 percent of former packing time

the rear and front counterweight checks can be slid into 20 special slots along the other side.

In certain machining divisions, truckers move the dollies along the line from machine to machine. Elsewhere the operators advance them. Truckers supply rough forgings to all lines according to schedules.

Novel handling operation is that in which supplies are elevated to general stores. Located on a balcony, general stores contain toolcrib supplies and other items. A regular hand truck with heavy meshing around it is attached to a four-chain, 1-ton, electric lift, is raised to the balcony, and pulled aboard in much the same fashion as freight is swung onto the deck of a ship. This simple device eliminated a costly elevator installation. It has flexibility and speed.

Ninety-Six Cranes

The system of overhead cranes is extensive, handling 90 percent of all parts. Machining lines are served by 96 distinct units of the monorail variety. There are 80 26-ft. and 16 10-ft. cranes, each powered with an electric hoist of 500 pounds capacity, controlled by pull switches.

Rope slings, leather slings, and two-prong steel hooks, rubber-tipped, are used at various stages in the shaft's assembly. Only $\frac{5}{8}$-in. round steel hooks are used in moving finished shafts. Safety is the determining factor in this specification.

On the average, a crane covers approximately 30 feet of machining line. This varies, however, depending upon the nature of the work in a given section. In the front section the cranes are limited to not more than a 20-ft. spread.

Serving the inner driveway, at either end of the plant, is a two-ton electric hoist. This works in conjunction with the two 5-ton hydraulic platform lifts set into each of the driveways.

Trucks unload heavy material and forgings onto these platform lifts. Forgings are stacked on steel skids, 31 x 60 inches, which are moved into stores by means of lift trucks or by electric industrial mobile conveyors. There are 2 lift trucks, 3 conveyors, and 100 steel skids in use.

Halves Packing Time

Stepping up final handling of the finished crankshaft is the development of a heavy corrugated packing box for shipping the shaft. It replaces former wooden packing cases and cuts packing time by 50 percent.

Made of double-strength board and containing ingeniously fabricated collars for holding the shaft in place, it resembles a giant suit box approximately 36 x 20 x 10 inches. Top and bottom are solid pieces. Special compartments for counterweights are set in. The box is strapped with $\frac{5}{8}$-in. 20-gage steel so placed as to give support where shaft weight is greatest. One carton can be used at least five times.

Results? Regretfully, because this is a defense plant, figures revealing results and totals cannot be given. Suffice it to say that the ease and dispatch that now characterize the passage of a given part from its rough to its finished state, are steadily being improved. Operations today are 25 percent faster than they were in September. All of which is the more remarkable when one considers that this entire operation was started literally from scratch barely a year ago. Much of the credit for the progress that has been made must naturally be attributed to the careful planning in the initial stages—planning for the maximum output at minimum effort that is so necessary to a successful conclusion of America's war program.

5

MAJOR STEPS to INSURE WAR PRODUCTION

« A Message to Plant Operating Executives »

★ **Put All Machines to Work**

★ **Work Machines All the Time**

★ **Use the Most Efficient Methods**

★ **Build an Adequate Working Force**

★ **Keep the Working Force at Work**

★

FACTORY
MANAGEMENT AND MAINTENANCE

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Salvaging Scarce Metals

Part of the operator's job is to segregate chips, borings, and turnings right at his machine. Trimmings can be used for smaller parts of the same analysis and gage. Adds up to considerable savings of hard-to-get metals

R. W. HUGHES, Superintendent, Reclamation Department, Caterpillar Tractor Co., Peoria

Crop ends and trimmings are stacked in the reclamation department, each stack marked with its analysis code. Templets of parts that can be made from this salvaged metal hang on a nearby rack

FORTUNATELY FOR OUR SUPPLY of the scarce alloying metals, four years ago we set up a salvage section to devise the best method of handling, disposing, and utilizing all materials that might otherwise serve us to less profitable effect. Long before nickel, molybdenum, and vanadium became subject to governmental regulation and allocation, our reclamation department was carefully segregating all turnings and scrap containing these metals—because such scrap, when kept separate, can be used to achieve the maximum results in the cupola.

Any really effective plan of collecting and segregating these valuable waste materials has to start with the man at the machine. He produces the chips, borings, turnings, or scrap. Unless he keeps them scrupulously separated according to instructions, this part of the reclamation program bogs down before it has a chance to get started.

All our foremen attend biweekly conferences where important shop matters are discussed. When any new program is being introduced into the plant, these conferences provide an excellent channel for familiarizing the key men with it. This approach was used with reclamation, not at the very outset but after it had been going for a long enough time to feel out the selling points and the obstacles which lay in its way. Throughout, the effort has been to work so closely with the foremen in departments producing waste materials that they would understand the purposes and methods of the reclamation program and be in sympathy with it.

When the foreman knows what it is all about, he transmits this knowledge to his operators, and sees that they follow the necessary procedures. In our segregation of chips and turn-

ings, this responsibility is placed squarely on the man at the machine. When, for example, a machine finishes a run and shifts over to its next job, it is up to the operator to check the blueprints and see whether there is a difference in materials. Suppose he has been making a part out of mild steel, and is about to start on a part made of nickel-bearing steel. While he is setting up for the new job, he must be sure that the chip wheeler cleans out his chip pit or shifts tote boxes. If he slips up, it is considered an indication that he is a little on the careless side. As a matter of shop practice, any machine-shop supervisor knows that the man who does not get his chip disposal cleaned up during setting up is probably sloppy enough in all his work so that it will show up in his production and his scrap ratio.

Simple as Possible

We make no effort to carry our segregation of scrap to so fine a point that we separate turnings from such materials as 1 percent nickel-bearing steel and 3 percent nickel-bearing steel. This would complicate the enterprise tremendously, and would achieve no relatively worth-while result. What we are after is to avoid loss of the nickel, and we can accomplish this just as effectively by throwing all nickel-bearing turnings together. Eventually they go into the cupola. Iron in the melt must be analyzed for proper percentage of nickel and brought up to standard, anyhow, before it is poured.

Chips and turnings in our plant are segregated into four groups: Mild steel; nickel-bearing steel and iron; molybdenum-bearing steel and iron; grey iron. The reclamation department supplies the operating departments with steel-backed signs, white backgrounds and black letters, which read according to our classifications. Typical signs are "Nickel Turnings Only," "Nickel Bar Ends Only," "Grey Iron Borings Only." To guide chip wheelers, these signs are hung on the chip boxes, and in bays where these materials are collected, in all departments producting the chips that need segregating. If we can accomplish this segregation at the source, and maintain the identification throughout, it holds to a minimum the labor involved in the reclamation department. The operating departments identify the boxes with chalk marks when they have been filled with chips and the signs have been removed to empties. This method has one serious drawback. Sometimes the signs are

(Continued on page 178)

One Year's Salvage

Gray Iron Castings	6,954,240 lb.	84 cars
Nickel Iron Castings	1,009,440	13 cars
Nickel Steel Forgings	190,650	3 cars
Heavy Melt	24,941,280	228 cars
Light Gage	8,559,120	72 cars
Loose Turnings	34,497,120	504 cars
Nickel Bales	5,630,290	71 cars
Cast Iron Briquettes	19,529,400	244 cars
Aluminum	989,580 lb.	
Brass	77,976	
Bronze	515,352	
Copper	47,352	
Solder Dross	9,336	
Lead	17,000	
Babbitt	4,836	

Get Ready for Allocations

They won't come right away, but management should prepare now to operate under them. One result will be a big change in cost-accounting procedure

WILLIAM J. CASEY, Chairman of the Board of Editors, Research Institute of America, New York

ALL-OUT ALLOCATION is one of the imperatives of total war. The Supply Priorities and Allocations Board, top agency in the hierarchy mobilizing our economy for armament production, has already declared for this program. But allocation is still a policy. Allocation procedure is still in the study stage. A full-blown allocation program, by most optimistic OPM estimates, is still four months away.

The impetus of the war declaration is apt to speed up this timetable. But allocation can't be introduced overnight. For example, the farm machinery industry was to play guinea pig for allocation. The effort to allocate specific quantities of required materials to the farm machinery builders developed "bugs" in several directions. Result was that, instead of allocations, farm machinery builders came away with nothing but an old-fashioned priority rating.

To gear up for operations under all-out allocation, the first step, as indicated, is to get a picture of just how allocation works. Allocation is a system of control over scarce materials which releases *specified quantities* to *specified customers* for delivery at *specified times* and for *specific uses*. True, certain commodities (i.e., synthetic rubber) have for some months been allocated. All-out allocation would place *all* scarce materials under allocation control. This calls for a detailed inventory of available scarce materials in consumer's stock, in warehouses, in producers' stock, and elsewhere. More important, it calls for accurate data on quantities of each scarce material to come into the market as refining, fabricating, smelting, and other functions are completed.

Tremendous as is the task of compiling complete data on actual and anticipated supply, it's only half the job. Allocation is equally dependent on accurate estimates of month-by-month requirements of critical materials needed for the production of military, industrial, and consumer items, essential public services, repair parts, and capital improvements.

Just to assemble these data involves an intensive, carefully detailed survey of the most complex, most far-flung, industrial machine in the world. To make these data (when accumulated) mean anything, OPM must develop an over-all intelligence capable of first digesting supply and requirement data and then releasing available supplies to meet those requirements which contribute most to the military effort. This part of the job requires administrative and technical brains capable of weighing the importance of competing demands, of synchronizing not only the allotments to each industry or firm, but also the relative amount of each type of material allotted to an individual producer or industry. It must also simultaneously balance a string of objectives—full military production, a functioning national economy, maintenance of civilian morale. In sheer size and complexity, this allocation job dwarfs any combination of social and economic planning programs yet undertaken.

Transition from proirity ratings to allocation or rationing of specific quantities of specific materials will be gradual. The priority ratings and the priority instruments now used will continue to have a place when the transition is completed.

Allocation can't do the whole job. Raw materials can and will be allocated. However, in industries where there are a large number of producers and in areas beyond the raw material level, the preference rating system will still be used. Even where allocation

(*Continued on page* 188)

TAKE THESE STEPS to get ready to fit into the all-out allocation program, and to plan for operation under it:

1. **Understand allocation, what it involves, its timetable.**
2. **Get to know and learn to work with the industry committee and the OPM industry branch set up for your industry.**
3. **Try to fit in under the Production Requirements Plan.**
4. **Study production operations in the light of the objective and requirements of all-out allocation; move now to line up favorably the factors which will determine the quantity and direction of material allocations.**
5. **Get geared to assemble the useful data in seeking allocations.**
6. **Move now—and this should have been started long ago—to simplify and substitute; do everything to stretch scarce materials over a greater number of final products.**

As Chairman of the Board of Editors of the Research Institute of America, William J. Casey is in constant and close contact both with Washington authorities responsible for the defense activities of the Government and with business leaders wrestling with the problems of a war economy. Recently assigned to direct the Institute's Washington Bureau, he operates between there and New York on a commuter's schedule. The constant flow of information and advice going out from the Institute to its more than 25,000 members places Mr. Casey at a pivotal point in the intricate business-government relationship in these exacting and difficult times.

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25 CASE STUDIES

Health and Safety

FOR AMERICA'S WORKERS

Cover photographs taken in Caterpillar service building for foundry employees (see page 81)

★ CASE STUDY NO. 1 — THE VISKING CORPORATION

Everybody Wins Here

Workers gain, in money and well-being, from the Visking health program. Company benefits through lower compensation costs, reduced absenteeism, and better morale.

To its effective medical service and health program The Visking Corporation attributes a reduction of at least 1½ days of absence per employee per year—which, since the company has a disability wage plan, means a direct saving of more than $11,000 annually

MEDICAL SERVICE AND HEALTH programs in industrial plants are usually developed through experience and study over a considerable period of time. The small plant begins by providing first-aid equipment and instruction in its use. As the plant grows, a dispensary may be provided, a nurse hired, and a doctor secured for part-time attendance. Accurate data on injuries, sickness, and absences can then be presented to management. Estimates of their influence on operating costs may be studied to determine what amount may be spent in their reduction.

Finally, the effect on morale of a sincere and practical concern for the health of its workers will guide the policies of the organization. Until this stage of development is reached, the losses arising from inattention to industrial health will far outweigh the money spent on an inadequate service.

The details of a satisfactory medical and health program are partly determined by circumstances peculiar to each plant and to its processes. These principles should guide management in any case:

1. The medical department should be conveniently situated and available to every plant employee.

2. The staff should be competent and capable of obtaining the confidence of all.

3. The equipment should be suited to the needs.

4. A high official of the company should have direct responsibility, insuring full cooperation from all departments in the plant.

5. Complete medical records of examinations, injuries, and sicknesses should be kept of every employee; these records should be confidential, under lock in the department.

6. Frequent summary reports, including costs, should be prepared at regular intervals.

7. The medical department should prepare recommendations regarding accident and occupational disease prevention, sanitation, working conditions, and general health measures based on studies in the plant.

8. Facilities for distributing information to all company employees should be provided.

With a medical and health program functioning in accordance with the above principles, definite savings will result. To illustrate, the experience and practices of this company, located in the Clearing Industrial Districts, will be drawn upon.

Manufacturing began on a very small scale in 1926. No physical examinations were given and only first-aid kits were available to employees. Four years later, with 175 employees, a full-time registered nurse was hired, and a first-aid room furnished. Compulsory pre-employment examinations were instituted in 1932; a part-time doctor was employed in 1937; periodic re-examinations were started in 1939.

Today, with approximately 1,000 employees, the program includes a disability wage plan, hospital and surgical insurance, instruction in first aid, distribution of health information and material, supervision of hazards, cooperative studies with the State Department of Health, and research.

Undoubtedly our accident experience has been favorably affected by our medical program, although we have a separate safety organization. The immediate and thorough care, practical elimination of infections, tabulation of causes and types of injuries, and supervision of work assignments and general health have helped greatly in reducing both the number and the severity of accidents.

By A. G. HEWITT, Superintendent, The Visking Corporation, Chicago.

Some measure of this may be found in a comparison of accident-frequency statistics. In 12 years lost-time accidents have been reduced from 13 per 1,000,000 working hours to an average of 2 per 1,000,000 hours over the past 3 years; in fact, over 2,200,000 hours have been worked since the last accident. A conservative estimate would be that our medical program alone has been responsible for a reduction of at least 20¢ in our compensation rate, equivalent to $3,100 annually, plus at least as much more in uninsured costs. This saving alone nearly pays the costs of operating the medical department —and, of course, the interest and morale of an organization resulting from its safety accomplishments are invaluable assets.

Absenteeism, too, has been greatly reduced. Published statistics of general industry reveal that the average worker loses 7 days annually through sickness. Our own records have been complete only during the last 4 years, but absences have declined steadily from an average of 4.8 days per worker to 2.6. This is probably too short a time in which to develop a true average, yet we feel that our medical service has directly effected a reduction of at least 1½ days of absence per employee per year.

The reduction has been accomplished by physical examinations, consultations, referring the employee to his personal physician when necessary, cold-prevention and vitamin treatments, and through the operation of hospital and surgical insurance. Since our disability wage plan provides for full pay for disability in excess of 2 days, the direct saving to the company through reduction in sickness amounts to about $11,200 annually; the indirect saving from elimination of delays, labor turnover, and waste is also considerable.

Our employees also have gained much from our health program, both in money and well-being. We credit our safety and medical activities with the prevention of at least 21 lost-time accidents per year. This has saved much suffering and maiming, and kept money in the workers' pockets; compensation payments are a poor substitute for earnings. Reduction in illness has saved our employees about $4,000 directly, which represents wages otherwise lost before disability payments begin.

This disability wage plan provides a maximum benefit of 13 weeks of full pay per year, beginning with the third day of absence. In effect for 3 years, it has proved very successful at a cost much less than anticipated. It has dispelled worry and fear, given opportunity for corrective operations and treatments, and permitted adequate periods of recuperation after illnesses. Abuse of the plan has been negligible.

Some of the data may be of general interest. Approximately one-third of our employees are women; we find that claims per 100 women employees runs about 2.2 times the claims for men. Average duration of disability is 10.6 days for men, 11.9 days for women. About one-fifth (18.1 percent) of our employees receive disability pay during the course of a year.

At the present time our medical staff consists of an experienced industrial physician and a registered nurse. Their quarters include office, examination room, first-aid room, two cot rooms, and supply room. Since some of our manufacturing is on a 24-hour basis, all operating supervisors and foremen are instructed in first aid. First-aid equipment is located in operating areas for use in emergencies; access to the medical department is provided for the supervisor in charge; and the services of a convenient emergency hospital are available. Cases are referred to the doctor next day.

Chemist from control laboratory takes a sample of air. Control of atmospheric conditions is primarily an engineering problem, but the plant medical department shares the responsibility. Workers in departments where hazardous chemicals are employed, are given frequent physical and psychiatric examinations. The fan shown here removes air from the hoods over the casing-making machines

Health Record

Before the employee is hired he is given a thorough physical examination. Results are recorded on a form which becomes a folder within which are filed the eye-test record and the serological report from the Chicago Department of Health. If he is injured at work, a first-aid report is made out by his foreman and sent to the medical department; after examination and treatment, the report is returned to the foreman with a notation indicating when the patient is to return for further examination. A comprehensive report of injury is also filled out by foreman, injured employee, and witnesses, and is sent to the medical department, and from there to the safety supervisor who initiates any indicated safety measures. A work-accident card is filled in by the doctor

or nurse and is placed in the employee's medical folder.

For illnesses occurring at work a different form is filled out by patient and foreman; the information is subsequently transcribed to the individual's medical card. Information on absences is obtained from the personnel department, which administers the disability wage plan and the hospital and surgical insurance; the nature of the illness is entered on the medical card, and if the absence exceeds a week, the employee reports to the medical department before returning to work.

Employees working in any area where toxic substances are present report monthly to the medical department for a check-up. For the annual physical examination, a card is sent to the employee a few days ahead of time, and an appointment is made; results are kept entirely confidential, and the employee is referred to his physician, if necessary.

A number of summary reports are prepared each month. The accident summary gives the number of injuries by types and by departments, and a comparison with the average for the preceding 7 years; the accident frequency of each department is shown, based on all injuries, no matter how slight, and copies go to all departments. A monthly progress report is also prepared. The monthly disability report gives number of illnesses, causes, days of lost time, and disability wage payments made.

As in most chemical plants, hazards resulting from handling materials toxic under some conditions have to be controlled. This is basically an engineering problem, necessitating proper equipment and adequate ventilation, but the medical department has an important responsibility in connection. From the laboratory it obtains frequent and comprehensive analyses of air in breathing zones, and studies of exposure are made. Standards of maximum allowable concentrations for safety are set up and maintained, and recommendations for further improvement in safety equipment are developed. Workers in departments where hazardous chemicals are employed, are given frequent examinations, physical and psychiatric. The able assistance of the medical and engineering staff of the Division of Industrial Hygiene of the Illinois State Department of Public Health deserves mention for invaluable help in developing methods of analysis and control.

Other phases of our factory operations which are related to the broad problem of industrial health are the cafeteria; wash, locker, and rest rooms; rest periods for female employees; the drinking water supply; housekeeping; the provision of salt tablets when temperatures are high; etc. The recommendations of our medical department are sought in many instances of this kind. Sports and recreations are also sponsored for their value as exercise and morale developers. An extensive schedule of interdepartmental baseball games, a bowling league, annual picnics, semi-annual dances, and skating parties are some of the activities.

A Mighty Good Buy

Has this health program been worth the cost? Well, the management finds that accidents and absenteeism have been sharply reduced, compensation costs lowered, efficiency and morale definitely improved. And the reputation of the company has been enhanced. Employees are healthier; those who do fall victim to injury or sickness have their hospital and surgical bills paid for them, and their regular income is maintained. Medical department costs, disability wages, and a portion of insurance costs now amount to but 2 percent of payroll. It looks to us like a mighty good buy.

★ CASE STUDY NO. 2 — THE RELIANCE ELECTRIC & ENGINEERING COMPANY

Dispensary Door Always Open

Round-the-clock medical service for full three-shift operation. Reliance program keeps pace with the company's rapid growth.

DOES IT PAY? Whenever two or three are gathered together to discuss medical service and employee health, somebody is sure to raise that all-important question concerning our own program.

Yes, it does, we are quick to answer. With a vengeance. In reduced absenteeism, at a time when every last man-day counts. In better morale, when the defense program is asking America's wage earners to exert every ounce of effort. In greater output, when every pound of production—in our case, every industrial motor—is vitally needed.

Our health program has kept pace with our growth. Most of the time I think it has been a couple of steps ahead. A few years ago, with less than 500 people in our plant, the dispensary was literally "out in the hall." The nurse did payroll work on the side. Today the dispensary has been moved from the hall into a neat and well-equipped suite of two rooms where two registered nurses are in attendance during the 7 to 3:30 and the 3:30 to 1 shifts, with a man trained in first aid on duty from 1 to 7.

Some change from the old days! We used to have to send men to a clinic, fortunatley only 7 or 8 minutes' walk from the plant. Today a doctor is at the factory Monday and Friday mornings, and Wednesday nights. And, of course, he is always on call.

Employees used to go to the dispensary only when told they had to go. Today they go on the slightest provocation. I mean, they don't have to be urged. They hustle over to see the nurse about the things they used to regard as trivial, but which sometimes became serious when neglected. They even consult the nurse about the baby's formula. The last is equally important. When employees begin to consult your medical department about their wives and children, you can be pretty sure that your program is getting somewhere.

It is, indeed, with some little hesitation that I admit that our dispensary is treating from 90 to 100 people every 24 hours. I hesitate because that may sound like a lot of people being doctored every day—perhaps too many for a plant the size of ours, although operating three shifts now—with between 1,100 and 1,200 on the payroll. However, let me assure you that the apparent popularity of our nurses and their dispensary is not to be set down

By S. B. TAYLOR, Works Manager, The Reliance Electric & Engineering Company, Cleveland

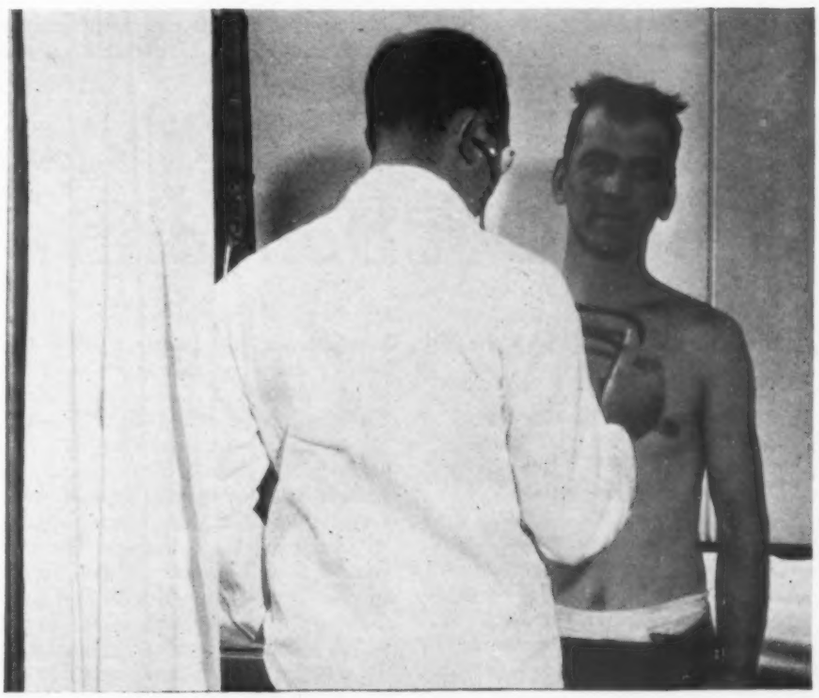
In for an aspirin tablet this time. But it could just as well have been for a cold immunization treatment, or for expert advice on which vitamin is which. Approximately 200 people at Reliance took the "cold cure" last winter; between 300 and 400 have been supplied needed vitamins at cost

to any unhealthy or hazardous condition, but purely and simply to the indisputable fact that Reliance employees are sold up to the hilt on their medical service and health program.

I say "their" program because it begins the day they are hired—before they are hired, in point of fact—with the pre-employment examination. The latter is a complete physical check-up, including pulse, blood pressure, eyes, urinanalysis. If, at this time, traces of sugar or albumen are found, or if blood pressure is either too high or too low, the employee is advised to see his own physician.

A complete medical record is kept of every employee—on a simple 5x8 card. When the card is filled, the data are transferred to a permanent typewritten health record. This record is retained even after the employee leaves the company, and is therefore available in the event of his being rehired.

We gave cold immunization treatments to about 200 people last winter —with such good results that the practice is being continued this year. Treatments are optional, of course, and are given at cost. Oral treatments,



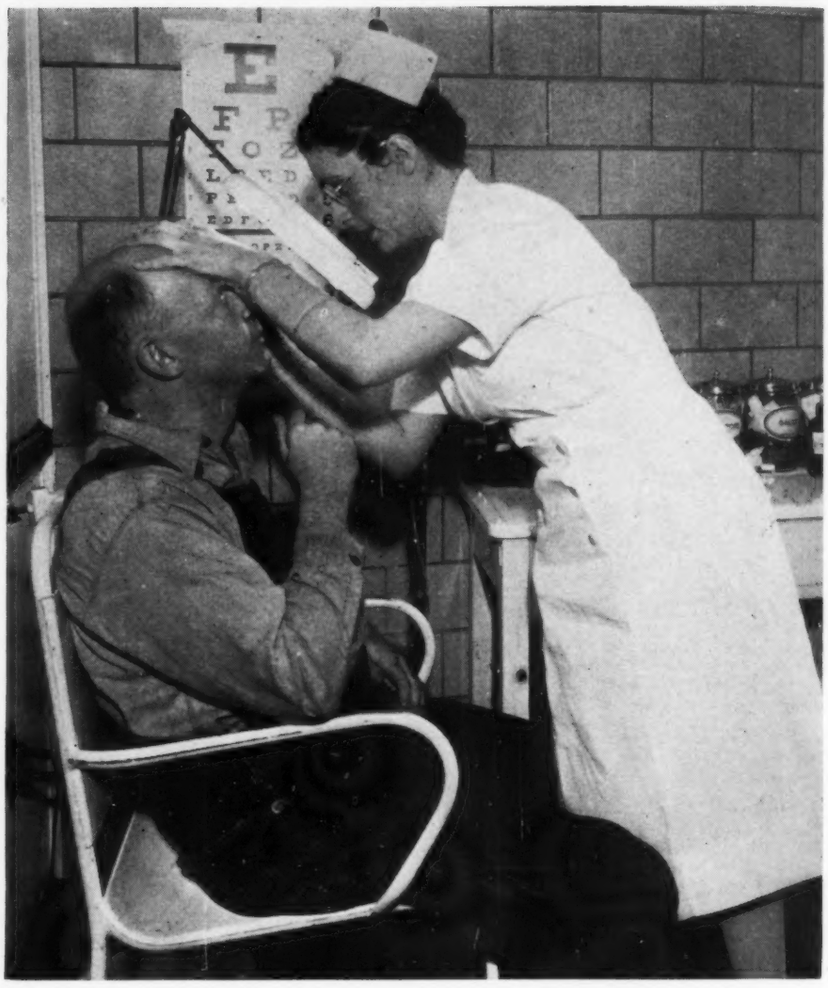
Employees are sold up to the hilt on their health program. It begins the day they are hired—with the pre-employment examination

for example, which most of our employees prefer to the hypodermic kind, cost the patient $1.75.

Similarly, during the year just ended, our doctor has given advice on vitamin feeding to somewhere between 300 and 400 people—vitamin C for skin eruptions, B for nervous conditions, ABDG for general build-up. These, too, we have found successful although it would naturally be difficult to measure the results. We are perfectly sure, however, that they have done much to raise the general level of health among our employees. Vitamin treatments are likewise supplied at cost, which can be deducted from an employee's pay if he so indicates. All he has to do is sign a payroll deduction slip; he can even specify the paydays when he'd like the money taken out. We also have a group hospitalization plan in which 75 percent of our people participate. The cost of participating in this also is taken care of by payroll deduction.

Nothing Fancy

Our dispensary is a simple one, consisting merely of a first-aid room, size 9 x 15, with linoleum floor and walls of salt glazed tile. A small adjoining room is used for physical exams and heat lamp treatments, and also contains urinanalysis equipment. The main room has a desk, washbowl, sterilizer, cot, and cabinet for supplies. Nothing fancy. Possibly the bare minimum for a plant of our size. But all, we feel, that any manufacturing plant actually needs in order to do a good job.



Reliance workers have the dispensary habit. They hustle right over to see the nurse—on company time—about the things they used to regard as trivial, but which sometimes become serious when neglected

★ CASE STUDY NO. 3—J. GREENEBAUM TANNING COMPANY

Wiped Out Dermatitis

Just one of many results in tannery where health program is stripped to fundamentals. Full-time registered nurse runs show, with doctor on call.

SOMETIMES I GET ANNOYED when I hear plant managers say that it is impossible to organize an efficient health program without employing a full-time or part-time doctor. My experience with this firm proves that a company with as many as 700 to 800 people can do much toward improving health and lessening accident frequency with the aid of a doctor on call, and a full-time registered nurse.

I was hired in October, 1935—the first nurse this company ever had. My headquarters consist of a first-aid dispensary and my private lavatory and dressing room, located as near the center of the plant as possible. The dispensary is well lighted and ventilated, and has been equipped with two cots, chair with headrest, portable lamps, my desk and filing cabinets, as well as the necessary instruments, drugs, linen, and extra dressings.

We do not have pre-employment examinations. Our present method is for me to interview all applicants. I fill in a health record form I devised, which gives us a great deal of information about the prospective employee. This procedure has proved helpful, but it is not as effective as a complete physical examination. The health records are, of course, filed for future reference.

Every employee who is absent because of illness or injury, no matter how slight, is checked by me. I keep a card record of every absence. When a man does not show up for work, or goes home during the day, the fore-

By A. B. SCHOOFS, R. N., J. Greenebaum Tanning Company, Milwaukee.

man takes his timecard from the rack and inserts a pink absentee card, which is filled out by the employee on his return and sent to me.

From these cards I make my absentee reports, and can soon tell if a worker is staying away too often, if too many are absent on one day, if there are more absences from one department than the others.

If too many people are ill in one department, there is usually a cause. It may be some working condition—perhaps poor ventilation, drafts, or insufficient lighting. My records give us a chance to check and correct any condition that makes for more than normal absenteeism.

Every employee who has been under a doctor's care must bring me a slip to show that his physician considers him well enough to continue his regular work. Whenever possible I make home and hospital calls.

For the times when I have to be out of the plant, I have trained a girl who can take over. She always knows where I am and can reach me in an emergency. At night a first-aid man is always in the plant. If it is necessary he calls me.

Dermatitis is known as an occupational disease hazard in a tannery. When I first came to work here at the Greenebaum plant, there were quite a number of cases in the plant. Knowing how expensive this hazard can be, I took steps at once to do my best to wipe out the disease.

First I obtained a list of every employee on the payroll. Then I had them all report to the first-aid room, where I examined their hands and arms, where a leather rash always develops first.

All suspicious cases were sent to the doctor for a complete diagnosis, and all positive cases were transferred to other work.

Then we started a semi-monthly inspection at the timeclocks, where foremen check the hands and arms of the people in their departments. Protective ointments are used, personal hygiene methods are taught, and only good soaps are provided. In the past two years we have had only one case of dermatitis each year.

We have had people who broke out, but our efficient checking system gives us an opportunity to catch the first signs and to transfer susceptible people to other work.

We take great care in selecting new help. No people with allergies or hayfever are employed, as they generally break out with a tannery rash. No one who is subject to hives or other rashes is hired. And I find that blondes and redheads are risks. We don't make these stringent rules merely to rule out dermatitis in the plant, but also for the good of the applicant.

HEALTH APPLICATION RECORD

Name:_____ Age:____ Married, Single, Wid.:_____

Surgery of any kind ever performed?_____ Ever had to wear a truss, corrective appliance, suspensory, etc.?_____

Back strain, injury, kidney trouble, lumbago, appendicitis?_____ Ever had any injury or accident?_____ Collect any compensation or insurance?_____ Ever had any rashes, acne, etc.?_____

Skin treated?_____ Skin sensitive?_____

Any illness?_____ Any broken bones?_____

Have you seen a doctor in the last three years?_____ Have you lost any time in the last three years through sickness or injury?_____

Ever had a blood test for syphilis?____ Result?_____ Ever been in the hospital as a patient?_____ Ever had any sign of rupture?_____ Are you seeing a doctor at present?_____ Any illness at home?_____ Defects or deformities?_____ Ever had blood poison?_____ Last joo?_____

Heart trouble?_____ Any contagious disease?_____ Stomach ulcers?_____

Any TB contacts?_____ Nervous disorders of any kind?_____

Epileptic fits or St. Vitus dance?____ Hives____ Eczema____ Rheumatism____ Pleurisy____

Pneumonia____ Goitre____ Menses____ Boils or carbuncles____ Weak or dizzy spells____

Asthma____ Hayfever____ Bronchitis____ Exam of eyes____ Teeth____ Ears____ Nose____

Throat____ Applicant given first-aid instruction____ Wearing any bandages?_____

Need or considering operation of any kind?_____ Sprains or strains?_____

Ever had any X-ray pictures taken?_____ REMARKS_____

_____

_____

_____ _____

Applicant A. B. Schoofs, R.N.

Health record form was devised by the nurse in charge of Greenebaum dispensary. Not as good, she admits, as a physical examination, but gives her much of the kind of information she has to have

Many Members

We have an active safety committee in our plant, of which I am a permanent member. Other members are elected every three or six months. This gives many people an opportunity to serve on the committee, and therefore sends out more and more safety-minded men into the plant.

The committee meets once a month. I always prepare a report, and usually talk about the work I am doing, the type of cases, and the number of lost-time accidents, and suggest preventive measures.

A written record is kept of every safety meeting, and a copy is given to each member. We make use of all the safety posters, literature, film strips that we can get hold of, and try to cooperate in every way with our insurance writer. Every worker who enters the plant is given a shop and safety rule book which he must keep in his possession as long as he works here.

My records are complete and have proved most valuable. Every first-aid

visit to my dispensary is recorded (there are between 800 and 900 a month, with between 600 and 800 dressings and re-dressings). I also take care of all the accident records, all records pertaining to injuries, except wage information, and, of course, the absentee and health records.

I make monthly and annual reports to the management, listing the number and type of cases reported, costs of medical treatment and compensation, and lost time accidents. I have graphs to show much the health and safety program has cost over the years since I have worked for the company, and I am proud to say there has been a marked decline in costs. In the first year of intensive work a nurse can save her salary quite a few times, as well as the cost of the dispensary. And any investment in safety and health pays not only in money but also in lives and limbs.

★ CASE STUDY NO. 4 — GENERAL ELECTRIC COMPANY

Goggles in Cellophane

G. E. doesn't just hand a pair of goggles or a respirator from one man to the next. Every piece of personal safety equipment is sterilized before reissued.

Clean and sterile is the cellophane-wrapped personal protective equipment that is given to employees from stock as they need it

WHEN AN EMPLOYEE of General Electric's Erie Works asks for safety goggles or other personal protective equipment, the stockroom attendant hands it to him in a shiny, cellophane wrapper, sealed against dust and germs, and in first-class condition. This method of wrapping is the final step in a process of cleaning, repairing, and sterilizing protective devices that the company has adopted as an additional safeguard for its employees.

When goggles, helmets, respirators, or the like are returned from service, they are placed in a formaldehyde sterilizer before being repaired or used again. For example, a pair of goggles drawn from a tool crib for a special job, used only a few minutes and returned, must go through the sterilization process before being re-issued. In the same way, equipment returned for repair or cleaning, after days and weeks of service, likewise goes through the same process.

Equipment is sterilized in an airtight cabinet (actually a G-E refrigerator case from which the unit has been removed). The equipment is placed in the case and allowed to remain there until completely sterilized. The sterilizing agent is liquid formaldehyde, kept in an open container to permit evaporation into the case.

Cleaning of the equipment was formerly done by washing and brushing in an open sink. Now a standard G-E dishwasher is employed. Equipment is disassembled, placed in the unit and washed according to regular dishwashing instructions. As in dishwashing, the use of near-boiling water assures a quicker and better job.

It is sometimes found necessary to brush-clean some parts, such as the concealed or turned-over edges found on certain types of respirators. Inspection of the material before it is rinsed indicates when this is required, and a very little hand-scrubbing does the trick.

After cleaning, the equipment is reassembled, with new parts replacing all broken or worn parts. The "rejuvenated" pair of goggles or respirator is then put in a cellophane bag and placed in the sterilizer once again, with the bag left open, for about 15 minutes. It is then removed, the bag folded and sealed shut with staples, and returned to stock.

This system assures the user that the equipment he gets is absolutely clean and in first-class condition. Further, the transparent wrapper permits easy visual selection of articles from the protective equipment stock.

Glycerine added to rinse water restores gloss to rubber parts of goggles and respirators

By M. C. GOODSPEED, Safety Director, General Electric Co., Erie, Pa.

Air is drawn through the 1,600 lockers, keeps workers' clothes in good condition, removes locker odors

★ CASE STUDY NO. 5—CATERPILLAR TRACTOR COMPANY

Everyone Can Go Home Clean

Plenty of showers; hot water for all; lockers where clothes get aired; subterranean cleansing system; air-conditioned cafeteria—are features of employees' service building.

FINISHING TOUCH to any good health program is the modern service building. And a model structure of this kind is found in the spacious quarters provided by Caterpillar Tractor Company, Peoria, Ill., for the convenience of its foundry employees.

The building is of brick, 264 by 91 feet, one story high except for a two-story wing 91 by 80 feet. Cost, fully equipped, was $145,000. Inner walls are of salt-glazed brick, punctuated by windows of self-washing corrugated glass. Concrete floor.

No unsightly, unsanitary sand boxes in this building. A subterranean water-cleansing system carries away all refuse. Right inside the door is a large grating where a man can clean his shoes if need be. Dirt drops into a pit and is removed by running water. When he finishes his smoke, he tosses the cigarette or taps the pipe dottle into one of a series of narrow grating-covered traps, all part of the trash-removal system.

Locker and shower room, 75 by 184 feet, have nine circular washers spaced evenly down the middle of the terrazzo floor. Extending to the walls on both sides are rows of steel lockers and benches. Laundry and towel cabinets are centrally located. Unit heaters keep the temperature at the comfort level.

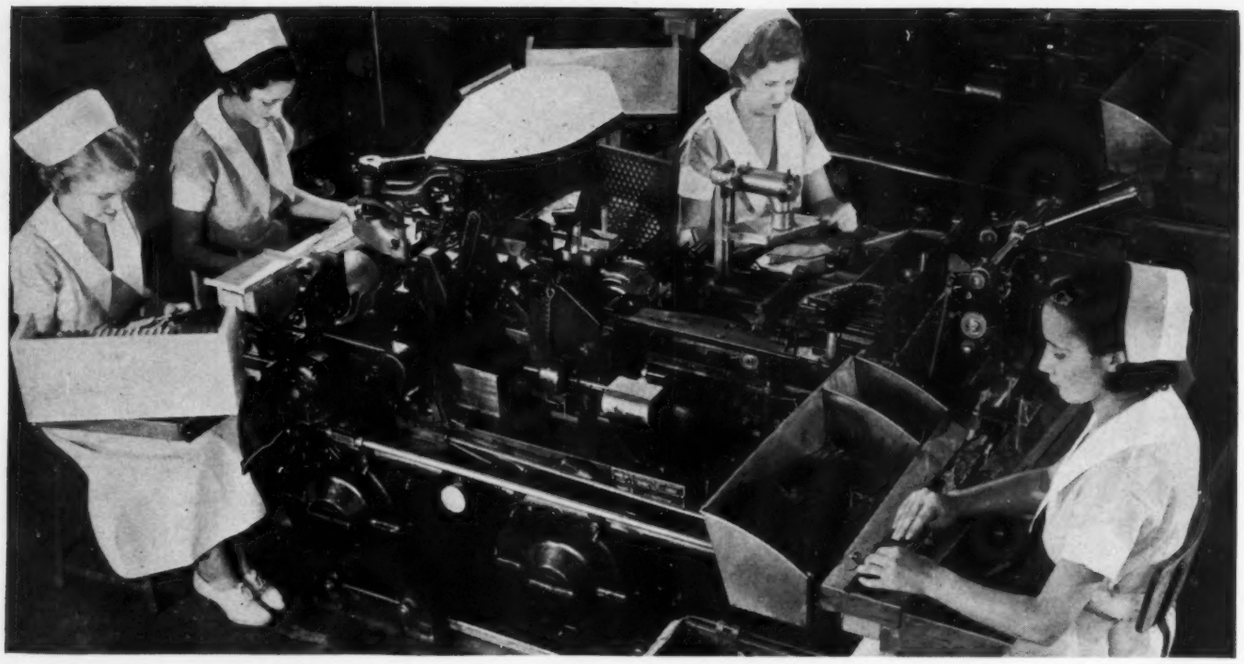
Fresh air, constantly circulating through the building, flows through each of the 1,600 lockers, entering top louvers and emerging through perforated bottoms.

Four shower sections, each with twenty sprays, have black and white tiled floors, walls and partitions of Tennessee marble, antiseptic foot baths, shaving facilities, hoods to carry away steam vapors. Hot water is provided by two instantaneous heaters, each of 3,000 gallons' capacity per hour. Three hot-water tanks (2,500 gallons each) take care of peak loads at shift changes when hot water is used at the rate of 10,000 gallons per hour.

An air-conditioned cafeteria, 75 by 140 feet, seats 196 men at tables equipped with retractible seats. Those who bring their own lunches sit on benches that line the lounging corridor running the length of the building. There is also a canteen in the corridor. Lunch periods are staggered so that all may make use of cafeteria facilities.

First-aid room (see section cover) opens both on the corridor and on a driveway at the rear of the building. Room is equipped with screens, sterilizer, eye chair, medical cabinets, work tables, cots, and stretchers.

The entire second floor is air conditioned and fluorescent lighted. It contains apprentice training classroom, foremen's conference room, and foundry office.



Bayuk got safety religion when an operator lost a finger on one of its well-guarded cigar-making machines

★ CASE STUDY NO. 6 — BAYUK CIGARS, INC.

The Hard Way Is the Only Way

Time was when safety was only a six-letter word in "America's safest plant." Bayuk progress has been written in blood, sweat, and tears.

PICTURE A PLANT that had 39 lost-time accidents back in 1934. Whose 4,400 people completed on March 10, 1941, an extraordinary run of 14,314,436 man-hours of all-safe operation—a new high for the manufacturing industries!

That is the safety progress recorded by our 9th Street plant where the insurance rate eight years ago was 51 cents per $100 of payroll. Today it is 12½ cents. Which means a saving of close to $19,500 in 1941 and approximately $90,000 over the past five years.

Progress indeed. And it was made the hard way, as progress in safety is always made. By "blood, sweat, and tears." Or, at least, their industrial equivalents.

"Accidents happen." A convenient phrase! A good alibi. We used it many a time in the early thirties to explain away a bashed foot or a cut hand. Not exactly with a shrug of the shoulders, to be sure. We were always mighty sorry when somebody got hurt. But, after all, accidents *did* happen—even in the best of plants. So what to do?

True, we knew about safety. A good idea. Must encourage it. So we paid our Safety Council dues. Got our posters. Tacked them up.

"What's the rate!" we'd ask when the insurance carrier's representative came round. But we filed away most of his recommendations under "things it'd be a good idea to do some day."

You see? Safety was just a six-letter word to which we were paying lip service—the same lip service we Americans give to so many of the things that are worth while in this transitory life.

But we got religion one day. And we've had it ever since.

It was in July of 1935. A young girl, 21, married and a mother, was laying binders in a cigar-making machine. She screamed. Her hand was caught in the crimper jaw. Seconds seemed like hours. At last her hand was freed. But she was to go through life without her second finger!

Now this cigar-making machine was guarded. Perfectly, I think you'd have said. Yet, somehow, it almost seemed deliberately, that operator had reached around the guard and got her finger caught.

Was it necessary for a young girl to suffer all that agony?

Did accidents simply "happen"?

Management and foremen, for the first time, began asking such questions—without, however, clearly seeing the answers.

The answers came a few months later, in the Christmas rush. We were wrapping cigars on a high-speed machine in our stamping department. The foreman had told the girl operator exactly what to do and what not to do, then had left the floor for a few minutes. The paste needed stirring. The operator reached over. A scream. When it was all over, another young girl had lost a finger!

And that was when we got religion.

Better guards? Of course. Yet they were only part of the answer. The wrapping machine, in all truth, was not too well guarded. But the cigar-

By M. L. WURMAN, Plants Manager, Bayuk Cigars, Inc., Philadelphia.

making machine had a good guard.

So what? So we realized that safety was more than paying dues and pinning up posters and putting on a guard after somebody had an accident. Safety, we knew at last, meant educating every worker in the plant, from the "big boss" down to the newest machine operator and the humblest sweeper, in the ways of safe operation.

And that is the why of the aforementioned blood, sweat, and tears.

We moved fast after those two terrible accidents. First we designated a supervisor to study safety methods in other plants. We got advice from the National Safety Council. From our insurance carrier. We went to the State Department of Labor for help. An inspector gave our plant the greatest going over you ever saw —and made 250 recommendations, all of which were promptly carried out. We found, for instance, that stackers had been ungrounded, a baling press had loose connections, an elevator had the inside door blocked so that the operator would operate without closing the door. Guards? We've installed more than 2,600 since our real safety push got rolling.

Too Much Discipline

Employee safety committees were organized. But it took only a few months' trial to learn that they were not the right approach to the problem. Employees knew nothing about safety in the first place. Also, these committees dealt out disciplinary action with much too heavy a hand. Laid off a worker for a week, in one case, for some minor infraction of the safety rules.

By this time we had learned that the supervisor was the fellow we were looking for. The next step, therefore, was the weekly safety meeting for 35 top supervisors and the formation of the Bayuk Safety Council. Safety now became a recognized part of the supervisor's daily duties. It was just as much a part of his job to eliminate unsafe practices as it was to see that the girls produced quality cigars.

Things were looking up. Our safety movement was getting under way. We were hanging up a pretty respectable no-accident record, only to have it broken by a girl's falling down the stairs on her way home from work and severely injuring her back. She was wearing high heels—and both of them had been broken off.

It was the first of three serious accidents caused by high heels. One could "happen." Not three. So we began campaign against high heels. We talked with employees, physicians, and also manufacturers of safety shoes.

"It's a great idea," commented safety men from other plants, "but you'll never put it over."

Yet we did. We did it just by the slow process of education. We disseminated information regarding the possibilities of accidents through the wearing of high heels. We sought the cooperation of some of our girls. A few began to wear low-heeled shoes. More and more caught on, until finally we had less than 50 girls who were still wearing high heels. Then we clamped down and made safe shoes a condition of employment. Today this rule is one that appears in our safety regulations:

"Wear shoes—strapped or laced, medium or low heels—foot entirely covered."

Well, there are 4,000 girls in this plant, so you will not be surprised

Golden tobacco leaf on uniform reads "America's Safest Workers." Bayuk employees hold safety record of 14,314,436 manhours without a lost-time accident

when I tell you that our next big problem was jewelry.

We went through the same educational procedure here that we went through with shoes—and then we ruled that no visible jewelry could be worn while working. Except wedding rings. We thought it was going a little too far, even for safety's sake, to ask a girl to take off her wedding ring. Yet we knew that even a wedding band constituted a hazard. There was always the chance that it could catch on something and cause an accident. So we did not ban wedding rings. Then a supervisor came to me.

"If we had an accident caused directly or indirectly by a wedding band, what would you do?" he asked.

"I'd see that all wedding rings came off," was my prompt reply.

"Then why wait?"

We changed the rule to read, "Wear no visible jewelry while working," and had only one serious objection—from the husband of one of the girls.

One thing we've found it necessary to do, and that is to keep the subject of safety constantly alive. Keep them wanting to buy what you have to sell, is the best advice we can give anybody.

Safety has been kept alive in a great number of ways. By safety messages to supervisors, for instance. Every week every supervisor gets a basic message to pass on to everyone under his supervision, using his own words. Many of these messages are about safety. The supervisor makes the rounds of this section, and before the week is out has passed the message on to each man or girl, individually.

By foreman's safety contests. They work if not tried too often. Don't make the mistake we once made of asking a supervisor to wear a large yellow badge which said: "My department had an accident this week." We learned from actual experience that any safety stunt that gives the supervisor a black eye is pretty sure to work with reverse English.

Attention Compellers

By posters. We subscribe to two services that supply posters, and from time to time have made some of our own. Posters are not to be overlooked as a means of promoting the cause of industrial safety. But they should be changed frequently.

By slogan contests. We have had three contests of this nature, with prizes of $25, $10, and $5. More than 15,000 slogans have been entered. The winning slogan in our first contest was written by a colored girl. It ran "Never feel safe enough to be careless" and was later used in a National Safety Council poster. "I can't be safe when you are careless" won the $25 prize in our most recent slogan contest. Good, isn't it?

By exhibits. The "bad apple" in 1940 showed 1939 accidents broken down by causes. And a life-sized figure, dressed like one of our girls, stimulated interest at another time by showing how many accidents to hands, arms, feet, etc., there had been during the previous month.

By warnings on doors and stairs. On stairs: "Be careful. Hold handrail. Watch your step." On doors:

EMPLOYEE SAFETY REGULATIONS

1. Report all accidents, no matter how slight, whether they result in an injury or not, to the dispensary immediately. Violation of this rule will result in instant *dismissal.*
2. No running.
3. Wear no visible jewelry — while working.
4. Wear shoes — strapped or laced, medium or low heel — foot entirely covered.
5. Use no cups or glasses made of breakable material.
6. Enter the elevators *slowly* and *orderly.*
7. *Walk carefully* and *slowly* on the stairs. Hold on to the hand rail.
8. Observe warning signs.
9. *No unauthorized person* is permitted to touch switch boxes or other electrical equipment.
10. "Horseplay" is forbidden.
11. All material or equipment must be placed solidly on the floor.
12. *Keep aisles, stairways, exits and fire equipment* clear of obstructions.

SANITATION REGULATIONS

1. Keep floors *clean.*
2. *No eating* permitted in other than designated places.
3. *No spitting.*
4. Keep water fountains, washing fountains and wash basins *free of refuse.*
5. Uniforms are to be worn in *neat* and *clean condition.*

THESE RULES PROTECT YOU - THEY MUST BE OBEYED

Failure to abide by any of them will result in disciplinary action.

BAYUK CIGARS INCORPORATED

"I CAN'T BE SAFE WHEN YOU ARE CARELESS"

No high heels. No jewelry. Safety and health rules are easy to learn. Bayuk's 4,400 people observe them

"Open slowly." And throughout the plant: "Walk, don't run."

Not the least of our devices to keep up interest in safety has been the recent change in our safety organization. Even the Bayuk Safety Council got to be an old story. So last summer we organized the "Bayuk Congress of Safety." It is modeled on the national government with its executive, judicial, and legislative functions. The executive function is represented by a president, vice-president, secretary, and cabinet; the judicial, by a judiciary committee; the legislative, by the top supervisors sitting as a senate and the section supervisors as representatives. All safety legislation is sponsored and passed by the senate. Members of the house may voice their opinions, but have no vote.

Meetings are held weekly. One decided advantage is that, whereas about 35 supervisors used to participate, we now have 60 to 70—just that many more people thinking and talking about safety. Sometimes we have a safety debate. A recent subject was: "Resolved, that there is an accident-prone employee." That was a hot one! At other meetings a man picks a subject out of the hat and talks for three minutes. Recently we had a hazard hunt. The men were given 15 minutes to see how many they could find. One man found 15 and won a box of cigars. At other meetings men have talked on assigned subjects. And so on.

Another thing. Every girl who comes into our plant gets a complete physical examination. We want to be sure her general health is good. Then she gets a talk on safety before she goes to work. At the same time she is given a copy of our very simple safety rules and asked to memorize them. She is introduced to the superintendent who is very sure to have something to say about safety. And her job is explained to her by the floor supervisor who teaches her to work the safe way. Finally she is turned over to an expert operator, watches the first day, works with the operator for 10 to 12 weeks, then goes to work on her own, knowing only the safe way and no other.

Which, I think, proves that a good job of safety is done with blood, sweat, and tears. Sweat, anyway. The tears come when you've gone 14,314,436 man-hours without a lost-time accident, only to have a maintenance man bring in an alcohol torch from home—which torch then proceeds to blow up and send him to the hospital for a few days. That ended for us two years and five days of all-safe operation. But it also started us off on another safe trip which on December 1 had passed 5,000,000 hours.

★ CASE STUDY NO. 7 — FARREL-BIRMINGHAM COMPANY, INC.

Displays Sell Safety Story

One of the difficult jobs in safety work is to sell the so-called "old-timers." Safety displays are a big help at Farrel-Birmingham.

SPECTACULAR STUNTS serve to arouse a certain amount of interest in safety. But spectacular stunts cannot always be staged. Safety is a matter of constant education.

We have found that the most effective way to sell a safety idea to old as well as to new employees is through the use of safety display cabinets and boards.

Exhibit A (see top photograph) is a display of unsafe tools picked up in our Ansonia and Derby plants. They were found in lockers and drawers, on workbenches, and actually being used on the job.

"An old one that just happened to be lying around," was one of the stock alibis. Our answer was:

"Well, if it's not used at all and is no good, then it never should have been left lying around for anyone to pick up and use."

As will be noted from the photograph, this was a good-sized display, and created much interest as it was moved about through the various departments of our plants. We cannot say in so many words that it has licked the unsafe tool problem for good and all, but it has certainly served to remind employees of the danger involved.

Exhibit B (lower photograph) shows a goggle display case containing a pair of goggles actually worn by one of our employees. One lens had been struck by a large chip and cracked. At the left of the goggles is the chip; at the right, the glass eye the man would be wearing today if he hadn't had his goggles on.

Display cases are light in weight and easily moved about. Doors are fastened with padlocks. And each case has a metal hanger so that it may be readily hung up in a conspicuous location. When employees see how one of their number was saved from a serious injury, they are much more inclined to use similar safety precautions.

By A. S. REDWAY, Vice-President, Farrel-Birmingham Company, Inc., Ansonia, Conn.

Nikolai Shilkevitch, clock number 849, was chipping a pinion housing in the Ansonia Erecting Shop. The chip shown in the display flew up and struck his goggles. The damage done was a broken lens, which a few cents will repair.

Had the chip struck his eye he would probably have had to purchase a new eye similar to the one shown.

Above are samples of the display boards and cabinets successfully used at Farrel-Birmingham to keep company employees sold on safety

★ CASE STUDY NO. 8 — LOCKHEED AIRCRAFT CORPORATION

Better Morale, Greater Output

How workers' club meets needs of 40,000 people in strange community whose social and recreational facilities were unable to carry the increased load.

ONE OF THE PROBLEMS created by the all-out national defense program deals neither with priorities nor government contracts.

It is the question of the morale of the defense worker and his family who find themselves in a strange and teeming community filled with thousands of other defense workers all striving for social and recreational stability.

The 40,000 aircraft builders at Lockheed Aircraft Corporation are no exception to this unfortunate result of the wartime boom, but those same employees have not accepted their predicament without making every effort to relieve the situation.

As long ago as 1935 when company payrolls tallied about 1,500 a small group of workers approached the management with a plan for organizing an employee recreation club.

A well-rated baseball team was showing a small financial return on games played throughout the Los Angeles area. The players, together with other men in the factory, had little difficulty in convincing the management that proceeds from games and other club-sponsored activities could be used for broadening the recreation program, and could even provide some amount of financial assistance to employees who suddenly found themselves in need of funds.

The unquestioned merit of the foresight that fostered the founding of what is now known as the Lockheed Employees' Recreation Club has been proved many times during the mad months of rapid personnel expansion which has seen Lockheed grow 2,000 percent in six years.

By OLLIE ARBELBIDE, Program Director, Lockheed Employees' Recreation Club, Lockheed Aircraft Corporation, Burbank, Calif.

Bowling? Of course. Lockheed has 262 teams. Women as well as men are enthusiastic participants in this healthful sport, one of many activities sponsored by the Employees' Recreation Club. Financed by profits from an employee-owned canteen system, the club enjoys full management support

Some like to play. Others to sit and watch. Much of the emphasis in the Lockheed program is on social affairs like last summer's monster picnic, when employees and families turned out 80,000 strong

Strictly an employee organization, the Recreation Club enjoys the full cooperation from Lockheed, but is in fact self-governed and almost wholly self-supporting.

From the first, it was apparent that before too long the revenues from baseball games would have to be supplemented. Therefore the Recreation Club sponsored dances and other social affairs which increased the treasury to meet a portion of the demands.

Once again management recognized that the manner in which the employees had directed the destinies of their club warranted granting permission to establish an employee-owned-and-operated canteen system.

At the outset this new Recreation Club project was successful, and with the mounting profits the entire program of the club was expanded to include not only the original baseball and employee aid but also such diversified activities as a drama club, ski club, rifle and pistol club, tennis tournaments, interdepartmental softball tourneys, both interdepartmental and All Star basketball squads. And, currently, the world's largest bowling league is wearing the colors of the Lockheed Employees' Recreation Club.

The club educational committee plans and sponsors a well-rounded lecture, motion-picture, and industrial-tour program; and a flourishing Boy Scout troop is proud to have the Lockheed Employees' Recreation Club as its sponsor.

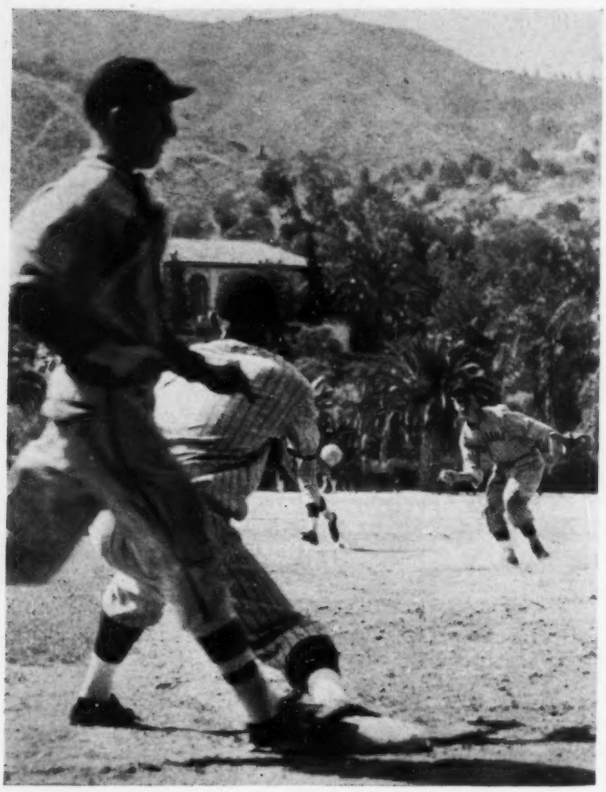
Of course, the most interesting thing about the club is the fact that it started with the employees, has been carried on by employees, and each of the many activities is directed by voluntary committee members selected from the employee council whose members are elected every two years by popular vote.

The success of this democratic type of employee organization is being confirmed daily, and the enthusiasm with which elected council members grasp the opportunity to have a share in the responsibilities surrounding the operation of the Recreation Club has demonstrated repeatedly that Lockheed workers are anxious to give time and effort to a constructive program such as is available through the club.

These same elected representatives act as departmental reporters for the employee-owned magazine. This magazine is given to all company employees once a month, and through its columns the entire club program is publicized and coordinated toward the most successful end.

The magazine, called "The Aircraftsman," enjoys considerable freedom of policy, and is furthermore operating presently on a self-liquidating basis under a paid editor.

It is difficult to put one's finger



Employees are proud of their baseball team, runner-up in the state tournament last year

Basketball? Interdepartmental teams and an All Star squad. Here, an All Star throws a practice basket

Yes, the girls shoot, too. Women employees and wives of employees enjoy all the benefits of the club

Then there's the service committee. Here, two of its members and two visiting nurses make a call

exactly on what the Recreation Club has meant to Lockheed, to the employees, and to the several communities surrounding the plant.

Much of the good lies beneath the surface, but several salient facts are known about the success of the club, and not the least of them is the general high social standards that obtain in the Lockheed ranks. All social agencies agree that the Recreation Club program is definitely creating constructive outlets for the many thousands of young fellows who find themselves far from home, family, and familiar diversions, and yet with considerable money in their pockets.

Also the various mass-entertainment features including free motion pictures, picnics, dances, and such activities as the camera club, the model club, the choral club, or the band offer outlets for both employees and the members of their families at no cost to those taking part.

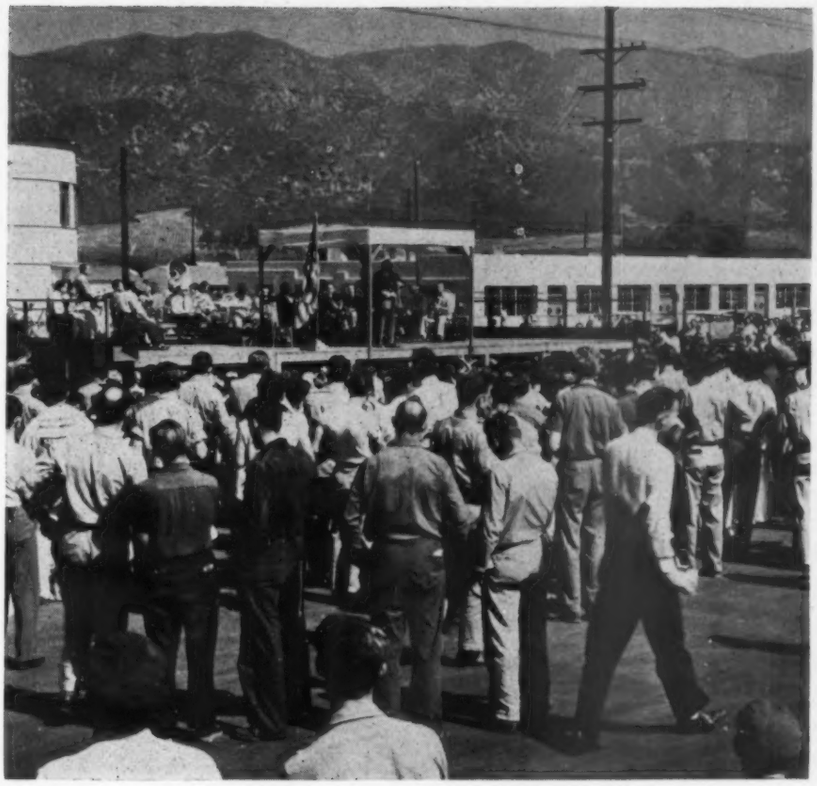
Where to Play?

Of course, the terrific influx of Lockheed employees and their families has strained the recreational facilities of almost all nearby communities. Also the schools and charitable organizations find their problems multiplied, but there again the Recreation Club and the several committees are doing a great deal toward relieving the chaos for the several civic governments affected by Lockheed's growth.

Athletic activities, mass entertainments, and such new projects as a mountain recreation area obtained through the cooperation of the U. S. Forestry Department go a long way toward decentralizing the Lockheed population after working hours.

As for the work of community charity organizations, employees take pride in the fact that, through the funds in the Service Committee of the Lockheed Employees' Recreation Club, needy employees receive prompt and thorough aid.

Under such circumstances, it is little wonder that Lockheed employees enter into their club activities with such energy and loyalty that they have made their own canteen system one of the most successful business concerns in the southern California defense area. They have established and elevated and developed the Recreation Club program to a point where employees of other companies are founding similar organizations so that they may offer employees and management the *esprit de corps* which self-reliance and self-management give those of the Lockheed Aircraft Corporation.



Lunch-hour crowd listens to club-arranged entertainment, provided this time by screen actor Edward Arnold. A camera club photograph

Employees on a tour sponsored by the Recreation Club's educational committee learn about radio broadcasting at NBC's Hollywood studios

★ CASE STUDY NO. 9—REVERE COPPER & BRASS, INCORPORATED

Play for All Who Want to Play

Trick in employee recreation is to let employees run their own show. This simple one that works so well is financed out of company canteen profits.

THIS IS A PLAIN, unvarnished tale of a recreation program in a plant with 1,200 employees in a manufacturing city of 110,000 people. The program is run *by* employees *for* employees. There are no frills. You may even say after reading this:

"Well, I don't see what they've got to brag about."

The fact is, we are *not* bragging. We are simply pointing out, with pardonable pride, we think, what an ordinary plant in the manufacturing industries can do about employee recreation —all, of course, with a view to improving employee morale, increasing company output, and building community good will. We are pretty sure we are getting results along those lines. In any event, our only boast is that we have come a long way.

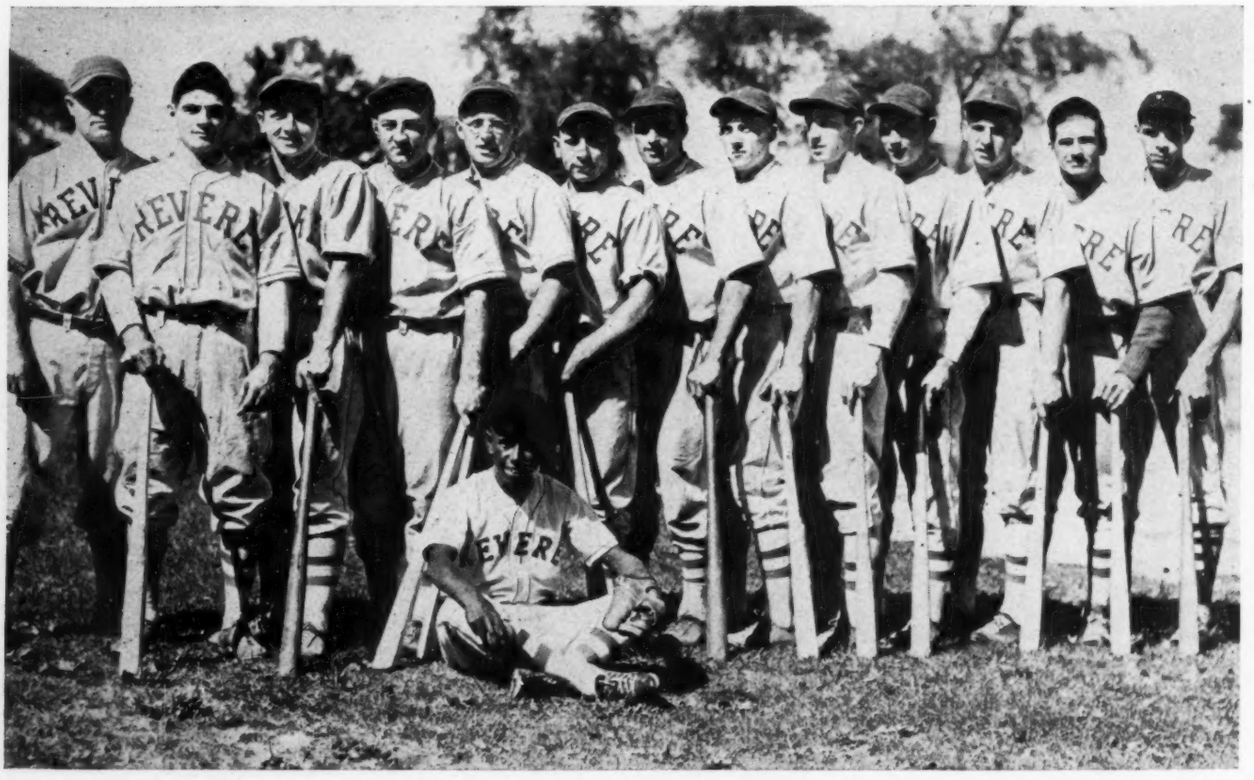
We began, as most concerns begin, with a company-proposed and company-controlled program. Right there we made the mistake of handing the employees something on a silver platter—something we thought they wanted, but something they had nothing to say about. I can speak freely because the program was originally set up under our direction.

Possibly nobody ever told our employees that they mustn't look a gift horse in the mouth. Anyway, it didn't take long to discover that this particular nag was not the one they were going to put their bets on. Suffice it to say that there was bickering and dissatisfaction, with the result that, four years ago, we turned the whole business over to the employees. Since then the recreation program has been run by employees through their own Revere Athletic Association—with an immediately apparent change in worker attitude and interest. The company has no hand in its operation, makes no contribution. A member of the personnel department acts, to be sure, as secretary of the association's governing committee, but has no vote, and the chief reason he is there is to remove the burden of paperwork from the committee's shoulders.

This governing committee consists of six men elected at the association's annual banquet, its present membership representing the machine shop, sheet and strip mills, inspectors, and office. The treasurer is the company treasurer, who serves in this capacity by request—of the employees, not the company. With him on the job they know that funds will be in good hands. There are no dues, and no special membership cards are issued. All new employees automatically become members of the Athletic Association as soon as hired.

Funds are provided from the profits

By PAUL A. SENFT, Personnel Manager, Revere Copper & Brass, Incorporated, New Bedford, Mass.



No made jobs at Revere. No ringers on the baseball team which won the city championship of New Bedford in 1938, 1940, and 1941. Every player is a *bona fide* employee who gets no special favors

of an employee-operated canteen system. There are four Coca-Cola, three milk, and a number of candy vending machines, both out in the mills and in the office. Profits from them have been more than enough to keep the association in funds. And I really mean "in funds." To illustrate, the association bought 25 turkeys a year ago Christmas and raffled them off among employees. This past Christmas, however, the number of turkeys was increased to 250—which meant that one out of every four or five people in the plant got free birds.

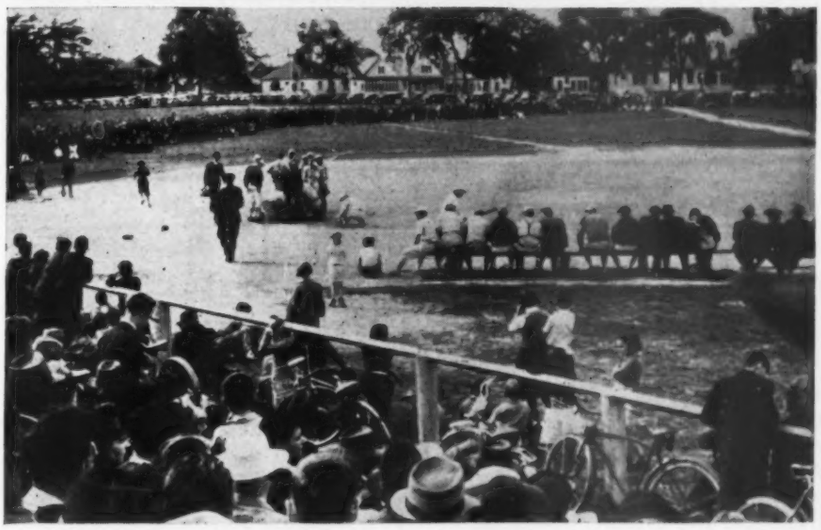
Witness also the big clambake and picnic held last summer. Tickets were sold at half cost, the association putting up the balance. Close to 1,400 people attended—and a fine time was had by all.

There is enough income from the vending machines to support baseball, softball, basketball, and bowling teams in city leagues. The Revere baseball team won the city championship in 1938, 1940, and 1941—and Revere teams have hung up fine records in other branches of sport. The association holds a banquet at the close of each season, invites the members of teams as its guests, and pays half the cost for other employees.

To Reach More People

The association's biggest problem at the moment is to devise ways and means of extending the benefits of its program to more of our people. I mean providing more opportunities for actual participation. Golf, for instance, has been tried, with some success. We had our first golf tournament last summer, and had 32 entries, more than half of them from the mills. It was a fair start, and the association hopes to better it next time. Bowling, so far, has proved the best bet in this matter of getting a lot of people to take part. Last year we had 20-odd teams in three interdepartmental leagues, and the association supported company teams in a couple of city leagues. It is important to note that players on company teams are all *bona fide* employees. No ringers. No special privileges.

As I said at the outset, we are not bragging about our recreation program, but we do think we are on the right track with a real chance to go places in this year of years when so much depends on the morale and health of employees. And we are sure our recreation program will be a contributing factor in the successful completion of Revere's share of the tremendous task that lies directly ahead of American industry.



Biggest social event of the past summer was the colossal clambake and picnic (top photograph) provided by Revere Athletic Association at half regular cost. . . . Play-off (middle photograph) for city baseball title draws enthusiastic crowd. . . . And here, snapped at the clambake (bottom picture), are the employees who run the recreation show

Health and Safety Shorts

CASE STUDY NO. 10

Short Talks at Noon

The safety idea is not new. It has been presented yearly to our employees by posters, letters, and bulletins, which have been posted on walls, in aisles, on stairways. However, this method does not reach all employees, because they do not all bother to read the posters.

Here at General Industries we are using a new idea. Once each week, at noon, a short safety talk is given over the public address system by our personnel manager, who is also in charge of safety. We know his message reaches everyone in the factory. This medium of selling safety by air has brought results. Employees of the various departments have offered suggestions whereby hazardous conditions can be corrected.

In walking through the factory while the safety talk is on, such comments as "It's the voice of safety," "Safety is on the air," and "Listen to safety" are heard.—*Allan W. Fritzsche*, Vice-President and General Manager, The General Industries Company, Elyria, Ohio.

CASE STUDY NO. 11

Special Truck for Motors

One of our employees thought a special hand truck would make it safer and simpler to move heavy electric motors into place in the bases of lathes, such as the 18-in. one shown in the accompanying photograph. He put his idea in writing and dropped it into the suggestion box. Result—an award of $5, and management's okay to build several such trucks.

Framework makes use of ¼-in. angles welded top and center to crossbraces of 1-in. pipe, and at the bottom to a platform made of ¼-in. plate, roughly 15 by 18 inches in size. This platform, on which the motor is carried, is reinforced with short side sections, likewise of heavy plate, which are welded to it and to the angles, forming the handles of the truck.

An angle strap is welded across the underside of the platform to act as a stop for positioning the truck and motor at the entrance to the cabinet base of the lathe. The truck platform, or "tongue," is pushed into the lathe base just as far as his crosspiece permits. It is then a safe and simple operation to shove the motor into position and remove the truck.—Source: The Monarch Machine Tool Company, Sidney, Ohio.

CASE STUDY NO. 12

Health Surveys Stop Occupational Disease

For many years specificaions have been written at all our factories covering the purchase of raw materials, methods of processing, and inspection of finished parts.

More recently the same plan was adopted relative to health hazards. Specifications have been written in which are listed all the potential health hazards and the means used to protect against each hazard.

The U. S. Department of Labor publishes a bulletin entitled "Occupational Hazards and Diagnostic Signs." We secured copies for each of our factories. The laboratories at the factories made a list of all the potential health hazards, using the pamphlet as a guide.

Later we had an insurance company make surveys of our factories to determine all conditions that might be hazardous to health. We gave them our formulas and they had access to the list of potential hazards drawn up by our own organization.

When all the information was gathered together, our engineers got busy and installed the equipment that was required for each potential hazard. This consisted in part of exhausting fumes, vapors, solvent gases, dusts, and so forth.

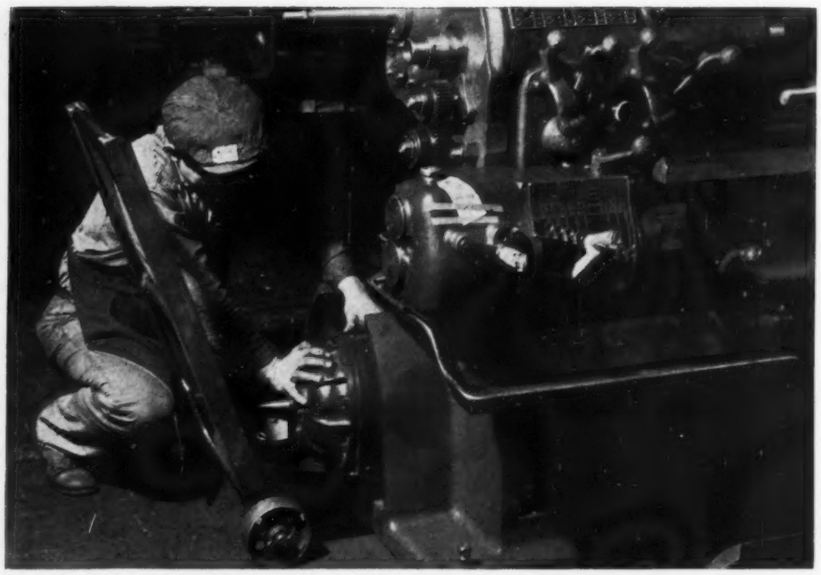
Specifications are constantly changing with the institution of new processes or the changing of older ones. Every specification change bears the following sentence: "This change does not increase nor add any fire or health hazards, except as stated in the body of the change." New hazards are noted, and a statement is made showing the means of guarding the operation in question.

Even though we have a rather wide variety of potential hazards in the various factories, only one lost-time case because of occupational disease has occurred in 1941. This was a case of dermatitis which the doctor diagnosed as an allergy.—*A. M. George*, Production Department, Armstrong Cork Company, Lancaster, Pa.

CASE STUDY NO. 13

They Can't Help Looking

We have developed a flasher sign which we use in conjunction with the safety posters we obtain from the National Safety Council. This flasher sign, mounted on a standard, comprises a box with four panes of glass,



At Monarch Machine Tool, specially built hand trucks carry heavy motors, place them in position under lathes, with speed and safety

two on each side. The poster is placed between the panes of glass. Under the bulb in the center of the box is placed a flasher button, which causes the bulb to flash on and off. Light shines through the poster from the inside, and brings out the outstanding features. These signs are placed in various departments, and it can be easily understood that they attract attention. Employees can't help looking at them—one more step in creating safety-consciousness.

Another thing we do to create safety-consciousness is to give the employees, in personal envelopes, a monthly letter which deals with off-the-job accidents. With the letter we inclose a safety pamphlet. In addition, we are having made an attractively designed safety emblem to put on an automobile license plate. It will carry the emblem of the International Business Machines, together with the words "Think—Safety First." One will be given to each employee. Although this is not directly concerned with industrial accidents, it is another step in reducing the man-hours lost because of off-the-job accidents.—*R. E. Frederick*, Safety Supervisor, International Business Machines Corporation, Endicott, N. Y.

CASE STUDY NO. 14

It's Safety Clothing Here

During the past year a special educational campaign has been conducted to acquaint our employees with the protection offered by safety wearing apparel. Meat-packing operations require the extensive use of knives, and hand cuts have always formed a large percentage of our total accidents. A safety glove worn on the hand that does not hold the knife has materially reduced this type of accident. These gloves are made of a fine metal mesh that prevents penetration by either the knife blade or the point.

Metal mesh gloves save many a finger from knife cuts at Swift

Abdominal guards, made of heavy leather with or without metal reinforcements, provide protection against body cuts that result from knife slips.

Our operations require transporting dressed meat and some of the larger cuts by overhead trolley systems. To prevent head injuries from falling trolleys, employees working in these locations are furnished with safety hats. Made of durable plastic, these hats are light and comfortable, and provide a high impact-resistance.

Wearing safety shoes with steel toecaps is encouraged where operators are exposed to falling objects. A survey to determine the best type of goggle for each job was made during the year, and on this basis goggles have been provided for all employees whose work requires them.—*Harold F. North*, Industrial Relations Manager, Swift & Company, Chicago.

A bottle of milk twice a day helps to keep workers at American Optical healthy, offsets fatigue period, increases efficiency

CASE STUDY NO. 15

Milk for That Tired Feeling

During the past year we initiated a practice that should help to improve the health and efficiency of our workers. There is, we believe, a definite relation between decreased efficiency in production and increase in accident rate. To offset the so-called fatigue period we are introducing between-meal feedings. At 10 o'clock in the morning and 3 in the afternoon, milk is served to the workers. Approximately 1,000 bottles of milk are now being distributed daily, and this amount will increase as the plan is adopted throughout our manufacturing departments.

Judging from our experience so far, this between-meal feeding has perceptibly increased efficiency and decreased accidents. Careful records are being kept, and by the end of the year we shall know exactly what the results are.—*T. L. Story, M.D.*, Medical Director, American Optical Company, Southbridge, Mass.

CASE STUDY NO. 16

Training in First Aid

One part of our safety program covers first-aid training for employees. We believe that such training does two definite things—it makes an employee safety-conscious, and teaches him emergency care of the injured.

Our course is short and is divided into five lessons, covering artificial respiration, control of bleeding, transportation of a patient, shock, and heat exhaustion.

Since our emergency hospitals are within relatively short distances of any part of our plant, we do not encourage first-aid dressings, but emphasize those functions that fall to the workers in the mill.

Classes are made up of about ten employees each. They meet for half-hour periods until all lessons have been covered.

At the completion of the course all members who qualify are given first-aid cards, which are signed by the superintendent of safety and welfare.

Classes are conducted on company

Vitamin A deficiency causes excessive eye fatigue. Westinghouse examines workers in binocular plant, feeds them pills when necessary

time. Foremen select their men from different sections of the departments to avoid interference with operations. Certified Red Cross instructors or holders of standard first-aid cards, all employees, teach the classes.

Over 2,500 employees have completed the course so far, and some of them have been able to use their knowledge of first aid both in and out of the mill.—*George C. Peters*, Safety Inspector, Jones & Laughlin Steel Corp., Aliquippa Works, Pittsburgh.

CASE STUDY NO. 17

Vitamins for Better Quality

To qualify for their jobs in the high-precision processes called for in manufacture of a $3,000,000 order for binoculars, employees will pass special tests to determine whether they are deficient in vitamin A.

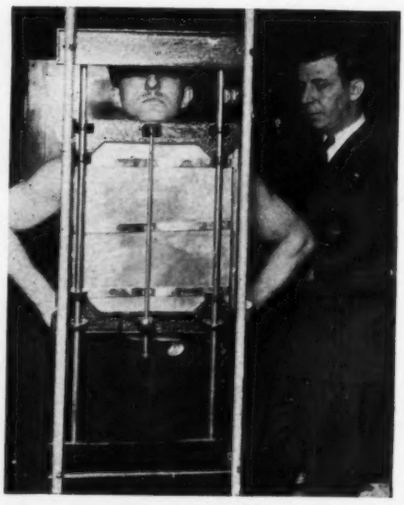
This plant was the first large industrial establishment to feed vitamin A capsules to employees to prevent eye fatigue. Up to the present, vitamin A therapy has been limited to inspectors responsible for matching exact shades of white on the enameled surfaces of electric refrigerators and ranges. Extension of its use to the manufacture of binoculars is believed to be its first application to production of war materials.

Army binoculars of standard design call for high precision work, requiring that metal fittings be accurate to within less than a thousandth of an inch. For this reason special attention must be paid to the sight efficiency of workers. It is expected that the use of vitamin A will result in reduction of rejections of material and much saving in production time, to say nothing of the added comfort it provides in preventing strain and fatigue of the workers' eyes.—*Source:* Westinghouse Electric & Manufacturing Company, Mansfield, Ohio.

CASE STUDY NO. 18

Exams for Tuberculosis

When Warner & Swasey offered more than 3,200 employees an opportunity to have a free fluoroscopic examination, nearly 95 percent accepted the invitation to check up on their state of health.



Fewer than three-tenths of 1 percent of Warner & Swasey workers needed T.B. treatment

The examination was given under the supervision of the Cleveland Anti-Tuberculosis League, using portable fluoroscopic equipment mounted in a special truck outfitted for the purpose by the League. Only three-tenths of 1 percent of the men examined were found to have any questionable lung difficulty. These men, because of the early detection of trouble, stand a good chance of complete and satisfactory recovery,—*Source:* Warner & Swasey Company, Cleveland.

CASE STUDY NO. 19

Less Handling by Hand

Through experience, shop men have learned that most accidents in heavy forging work result from handling of billets and hot forgings. Consequently, American Car & Foundry has eliminated, wherever possible, hand tongs, buggies, and so forth, in laying out the equipment for the production of 155-mm. shells at its Buffalo plant.

Gravity conveyors, with trips, carry billets from the storage yard to the breaking machine, into the furnace, through the press and drawing operations, and on to final inspection. Hand tools are used to guide billets into the furnace; otherwise, the only manual portion of this process is the operation of the controls.

When this work was done by former methods, it was necessary to use hand tongs to put the billets into the furnace, remove them and place them in the die pots; the forgings were conveyed from the press to the inspection racks and cooling areas on buggies.

This process is a far cry from the production practices of the last war and demonstrates that mechanical equipment, when designed for safety, also increases efficiency.

To round out the safety measures, heat curtains are part of the furnace equipment; de-scaling screens are used; and, of course, every workman wears suitable safety goggles, in line with the company's general policy of eye protection.—*Frederick A. Stevenson*, Senior Vice-President, American Car & Foundry Company, New York.

CASE STUDY NO. 20

A Safety Hint Every Week

In our plant the foreman is responsible for all safety and accident prevention. This is just as much a part of his responsibility as are production and quality of product. To keep the foremen on their toes, an accident

prevention hint is placed on their desks one morning each week. Color of paper and message are changed every week. Here are some samples of the hints:

Check floors and housekeeping for slipping or tripping hazards.

Caution all employees about reaching into moving machinery.

Are all employees wearing goggles when necessary?

Are all empty skids piled safely?

Is every machine guard in place?

Check all ladders for safety shoes and unsafe steps.

Are employees wearing rings or loose clothing around machinery?—*A. L. Brown*, Superintendent of Industrial Relations, General Foods Corporation, Battle Creek, Mich.

CASE STUDY NO. 21

Photographic Posters Tell Real Safety Stories

At our plant in Inglewood, Cal., an effective safety idea was recently rounded into shape through the combined efforts of the safety engineer and the photographic department.

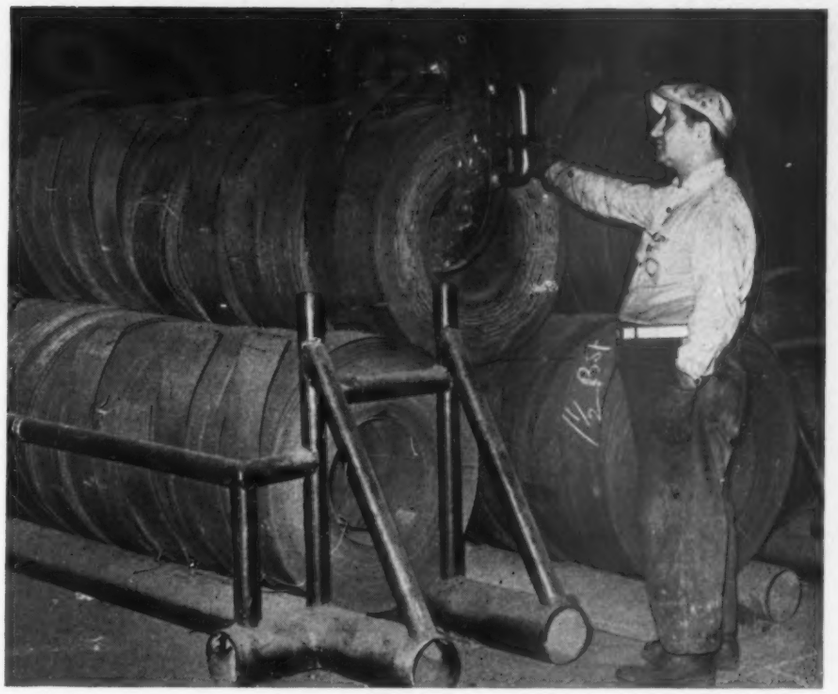
For some time the results of accidents have been photographed for the benefit of the insurance company and other records. This suggested making posters of typical accidents.

For example, one day the safety engineer brought in a pair of goggles with one badly smashed lens. This pair of goggles had saved the eyesight, and perhaps the life, of a workman. Why not take a photograph of the man involved in the accident, showing him grinning his appreciation from the top part of a poster, with the goggles shown in the lower half? This was done, a print was made, and the company artist painted in the word "Thanks" across the middle of the picture. Large photographic prints were put up on all the safety bulletin boards and at other strategic points throughout the plant.

Posters made from photographs of actual accidents carry a real punch at North American

The reaction was terrific. Everyone remarked about it. Why? Not just because of the idea or the planned situation—but just because it was an actual incident which happened in the plant. Nothing makes a man more careful than to see or know about something happening close at hand.

Photographic posters have many advantages. Accidents occur which are often not even conceived of by ordinary safety posters. When an unusual accident occurs, advantage should be taken of it to educate the workmen against that hazard. It can be done no more quickly or effectively than with a photographic poster.—*R. Wilkins*, Safety Engineer, North American Aviation, Inc., Inglewood, Cal.



Special coil racks for stacking steel, and a handle fastened to the big hook that picks up the coils are safety hints from Republic Steel

CASE STUDY NO. 22

Hook With a Handle

Two contributions to greater safety have been made recently in the equipment provided for handling coils of skelp at the Youngstown pipe mill of the Republic Steel Corporation.

First is the construction of special coil racks for stacking the steel. The heavier frame members have been made of $8\frac{5}{8}$-in. pipe. To these have been welded lighter 2-in. round bars to form the ends and sides. This arrangement effectively anchors the bottom row of coils in place, and permits the addition, with safety, of a second row on top of the first.

The second aid to safety is a small handle that has been fastened to the side of the big hook with which the coils are picked up. Here a $\frac{3}{4}$-in. rod, bent in a U shape, has had its ends inserted in holes drilled in the side of the hook and then welded securely in place. With this handle an operator is better equipped to guide the loaded hook into place without pinched fingers or other injury from the load shifting or sliding.—Source: Republic Steel Corporation, Youngstown.

CASE STUDY NO. 23

Making It Hard to Slip

A safety device that has proved outstanding in our plants during the past year has been an introduction of alundum-studded, and later alundum-slotted boards, made up into platforms and placed in front of machines where there is a slippage hazard because of splashes of cutting oils, soaps, solvents, and so on. With increased cutting speeds, in spite of splash guards, it is almost impossible to keep coolants from getting on the floors.

Various types of rubber and rubber-

covered platforms, steel platforms, and various other materials were tried, but the answer has been to use an oak board with ¾-in. abrasive plug inserts every 3 inches, or a ⅜-in. groove every 3 inches, which is filled with abrasive material. The latter method is especially good. This abrasive material stands out 1/32 inch above the surface of the board, and shows no wear under the wettest and most oily conditions. It is impossible to slip on a platform of this kind.

Men have been hurt when the platform itself slipped. This was overcome by making cleats of this material upside down, so that the abrasive material comes in contact with the floor. It is then impossible to make the platform slip even on the most oily or soapy floors.—*A. Lowe*, Safety Engineer, Wright Aeronautical Corporation, Paterson, N. J.

CASE STUDY NO. 24

Rank-and-File Workers on Safety Committee

We have put into operation an idea that has done a great deal for us in our safety program, and, no doubt, will accomplish results for others. In any event, we have been able to cut our insurance rate in half, and have twice been awarded first place for reduction of accidents by the National Safety Council. We have used all the mechanical means of preventing accidents, but felt that they could not accomplish our purpose unless everyone in the plant was safety-minded.

To accomplish this, we have on our safety committee, in addition to the regular members, a number of rotary memberships, representing the rank and file of workers throughout the plant. These men are appointed by the supervisors and quite often include workers who are not careful. They serve for a period of, say, 60 or 90 days, and then are replaced by others, until eventually practically all employees have the opportunity to serve on the committee.

Committee members are supplied with suggestion forms, on which all kinds of comments on safety and other working conditions are received. Actually hundreds of valuable suggestions have come in and are being used.

The main benefit, however, arises from the fact that each committee member feels a responsibility toward the safety program. This has built up a real interest in it, so that we get full cooperation, because all employees understand what we are trying to do and are ready to help to accomplish it.—*R. W. Cook*, Vice-President and Works Manager, Wallace Barnes Company, Bristol, Conn.

CASE STUDY NO. 25

Showing Up Unsafe Practices

Best method of combating unsafe practices in our Savannah mill has been through the use of photographs displayed in conspicuous places—in frames at our paper machines, for instance. Pictures are changed often.

The idea is simple. Whenever we see a man doing something he ought not to do, we re-enact the scene. We do not ask the culprit to pose, however, since that would be exposing him to shame or ridicule. Because employees know this, it is easy to get cooperation—in fact, they are eager to pose.

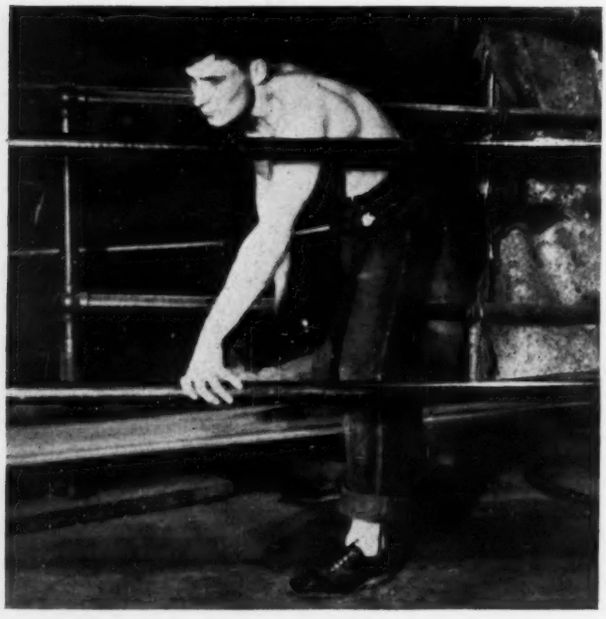
Shown herewith are two photographs that will illustrate the method. With the first, which shows a man crawling through a belt, we used this message signed by the paper mill superintendent:

"Not long ago one of our employees crawled through the moving belt of the Broke Beater. The next picture will show you why he was in such a hurry that he didn't think he had enough time to do the *safe* thing and go around."

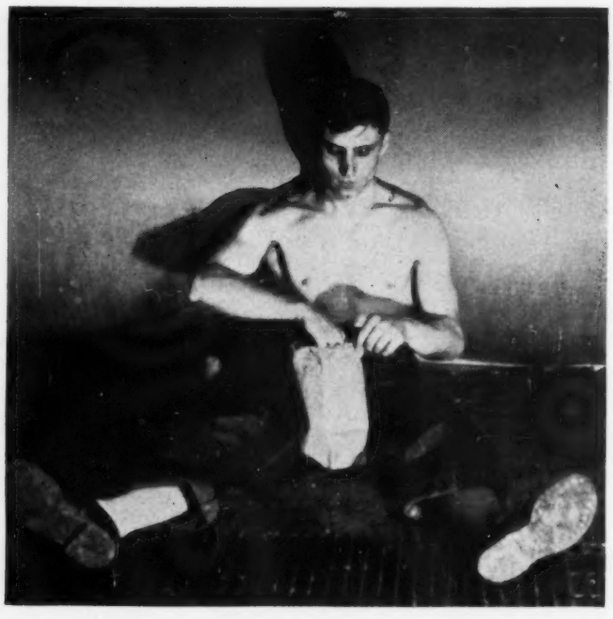
With the second picture we used the following signed statement:

"In the other picture we cited a case in which an employee was in such a hurry to get on the other side of the Broke Beater that he did the unsafe thing and crawled through the belt. Believe it or not, when he got on the other side he sat down and ate his lunch."

Photographs like the two shown always attract a lot of attention from employees. They keep people thinking in terms of safe operation, and have played an important part in helping us hang up our very excellent 1941 safety record.—*Jerome Pinckney*, Safety Supervisor, Union Bag & Paper Corporation, Savannah.



Took his life in his hands and stepped through the belt because he was in such a desperate hurry . . .



. . . to eat his lunch. Union Bag re-enacts unsafe practices, posts pictures to teach safety lesson

"Meet Mr. Budget"

Simple manual points out that each foreman should plan his own budget because he is the man who has to meet it. Since system was started, top management has been relieved of details, and problem departments have become operating stars

DALE PURVES, Treasurer and Production Manager, John B. Stetson Company, Philadelphia

IT TAKES A LOT OF TIME to chase information from one end of a plant to the other. If, for instance, we wanted to settle a question of quality of workmanship in our straw-hat department, we had to take an elevator to the fifth floor, cross a bridge, go through another building, cross a second bridge, and then go down to the first floor in that building. A few such trips and the day is gone. Furthermore, the front office had to concern itself with departmental operating decisions and policy. We would have to go out into the plant to take up the question of whether to dock a man, or how much overtime to work if a certain lot of goods was behind schedule.

Too Little Time

In other words, we found that we were being faced with so many operating problems that we had too little time to devote to our own work. We needed a decentralized control, whereby we would not be concerned with hour by hour departmental decisions.

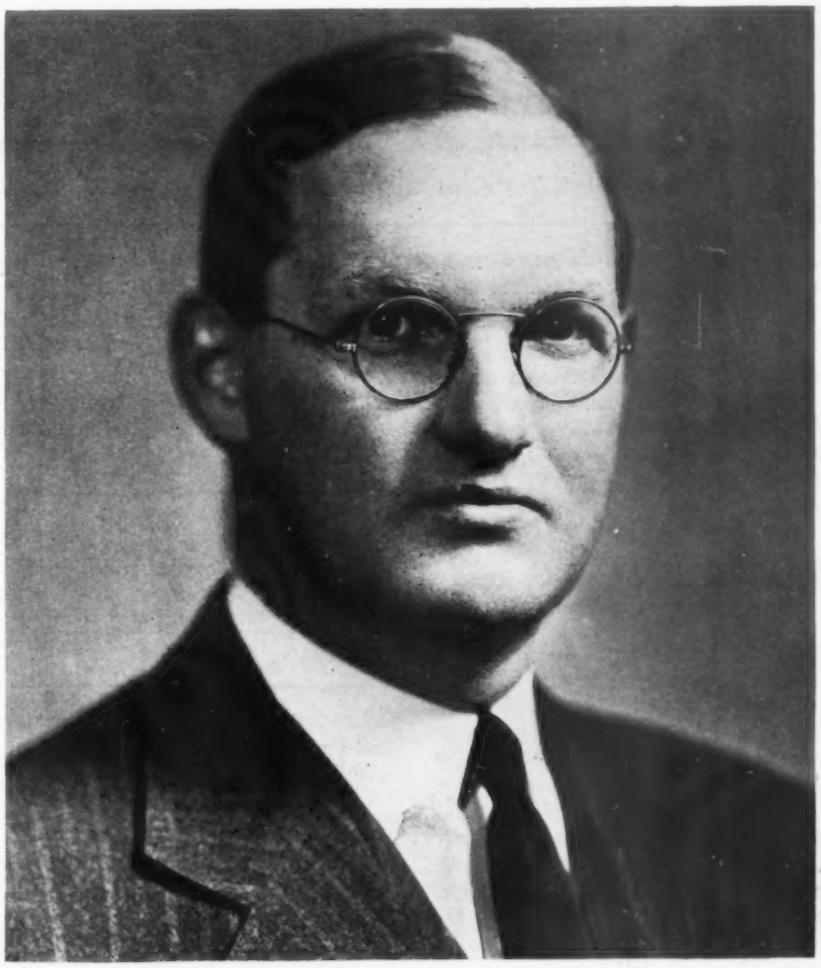
Early in 1940, we decided to take the matter up in our foremen's conferences. The immediate result was that our foremen were thrown into a tailspin. "I'm a hatter, not an accountant" and "Budgets are screwy anyway," were typical objections. Even after we got the foremen to admit the usefulness of a budget, the complaint was: "We fellows are not the ones to make it work; you have got to give us an accountant to run it."

My answer was: "If you can't make it work, you can't make your departments work. I know you are fine hatters. I am not interested in your becoming higher mathematicians, but I do expect you to know that two and two equal four."

Discussions on the budget divided our foremen into three groups—those in favor of it, those with no ideas at all, and those who opposed it. From among those who were quick to see the budget as a measure of accomplishment, we selected a committee of five men who worked with me in developing a simple manual which we called "Meet Mr. Budget." This manual points out that each foreman is best equipped to make the budget for his own department, because he is the man who has to meet it.

The committee also worked with the other foremen to: (1) Help them understand their budgets as outlined; (2) bring them the latest wrinkles and developments in the successful use of budgets; (3) find out their particular problems or discoveries so that their

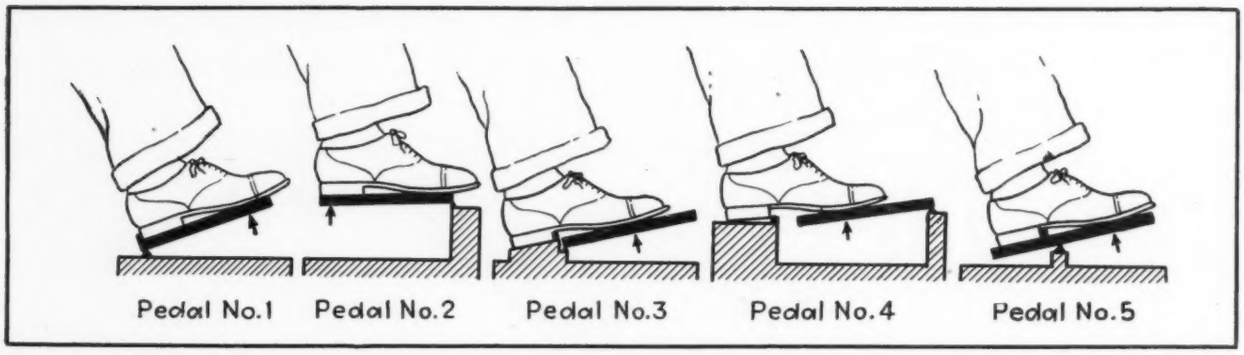
(Continued on page 200)



Being treasurer and production manager in charge of planning, inspection, manufacturing, industrial relations, and plant engineering does not leave Dale Purves too much time to travel—which is his favorite form of recreation. Born in 1901, he received his B.S. in mechanical engineering from the University of Pennsylvania in 1924. From there to UGI Contracting Company for one year, followed by two years with Curtis Publishing Company as industrial engineer. Thence to his present company, where he has held various executive positions for the past twelve years

Which Pedal Is Best?

Five pedals were clocked to find the most efficient, least fatiguing. Here is a University of Iowa study whose findings can be used in almost any plant*



Pedals were made of wood and securely hinged at the fulcrum by a metal hinge. They were 4 inches wide and 10 inches long, covered with rubber floor matting. Each required 20 inch-pounds of pressure

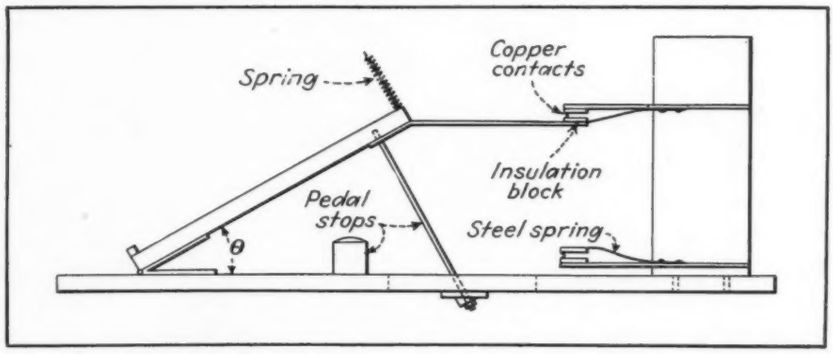
OBJECT OF THIS STUDY was to determine the relative effectiveness of five different types of pedals. Each pedal had a different arrangement of the fulcrum, which brought into use different muscles of the body and required different body movements.

The five pedals were made of wood and securely hinged at the fulcrum by a metal hinge. The pedals were 4 inches wide and 10 inches long and were covered with rubber floor matting. Each pedal was depressed against a tension spring requiring 20 inch-pounds for one complete stroke. For example, Pedal 1 had the fulcrum installed under the heel, the ball of the foot moving through a distance of 2 inches against a resistance of 10 pounds.

Pedal 1. Entire foot rested on the pedal with a stop at the back edge of the pedal which kept the foot in the correct position on the pedal.

Pedal 2. Fulcrum was at the toe of the foot with the back edge of the heel coinciding with the end of the pedal. The fulcrum or hinge was attached to a block 4 inches above the level of the floor.

Pedal 3. Fulcrum was at the arch of the foot, and the heel rested on a stationary block. The forward edge of the operator's heel was limited in its forward position by a strip of wood attached to the heel rest.



Side view of Pedal No. 1, showing location of copper contacts, stops, and tension spring. Here the entire foot rested on the pedal. A stop at the back edge kept the foot in the correct position

Pedal 4. Fulcrum was at the same position as Pedal 2, that is, under the toe of the foot. However, the heel of the operator's foot rested on a block attached to the floor. In normal position the pedal stood 1 inch above the level of the heel. That is, the fulcrum was 5 inches above the floor. The pedal was deflected from 1 inch above the heel level to 1 inch below.

Pedal 5. Similar to the foot-operated sewing machine pedal, with the fulcrum under the arch and the whole pedal pivoted around that point.

Copper contacts connected in series to solenoid-operated pencils on the kymograph* were used to time all the movements. To another set of copper contacts, which were attached mechanically to the kymograph contacts, there were connected in series an indicator light bulb (green or red) which informed the operator when the pedal had reached its downward or upward position. At the instant the light flashed the operator was to change the direction of the pedal motion. There were permanent stops to the pedal below and above the contact point, to which operators usually went.

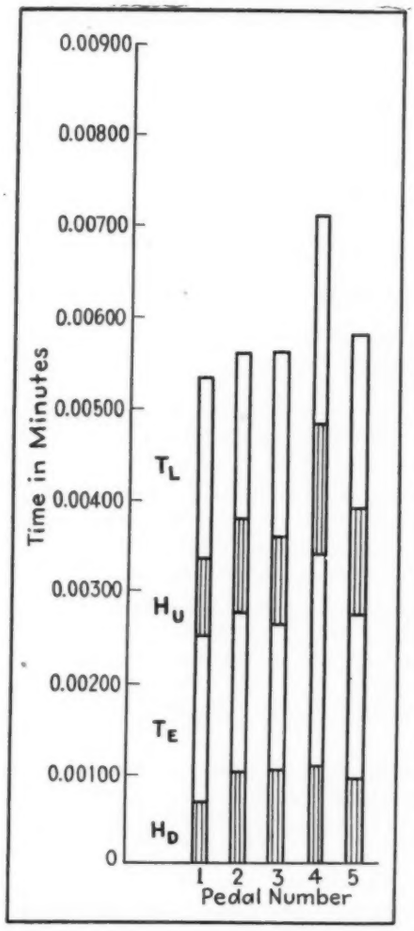
In this study fifteen operators were used, twelve male and three female. The operators were all given similar instructions in the manipulation of the pedals, and an explanation of the object of this study also was made.

By RALPH M. BARNES, Professor of Industrial Engineering, HENRY HARDAWAY, and ODIF PODOLSKY, College of Engineering, University of Iowa

* For a description of the kymograph and method of measuring time, see "Motion Study Research," FACTORY, Jan., Mar., June, Dec., 1939 or Mar., 1940.

Table I. Time (in Minutes) for Elements of Pedal Cycle

Element of Pedal Movement	*Pedal* 1	2	3	4	5
TL Movement of Pedal Downward	.001970	.001825	.002091	.002290	.001965
HD Change Direction At Bottom of Pedal Stroke	.000665	.001043	.001020	.001082	.000931
TE Movement of Pedal Upward	.001850	.001750	.001671	.002350	.001790
HU Change Direction at Top of Pedal Stroke	.000860	.001020	.000889	.001424	.001151
Total Time for One Complete Cycle	.005345	.005638	.005671	.007146	.005837
Strokes per minute	187	178	176	140	171
	Pedal No. 1 Required Least time per stroke	Pedal No. 2 Required 5% more time per stroke than No. 1	Pedal No. 3 Required 6% more time per stroke than No. 1	Pedal No. 4 Required 34% more time per stroke than No. 1	Pedal No. 5 Required 9% more time per stroke than No. 1



Graph shows time elements for each pedal cycle. This is the average time for fifteen operators

Steps Used in Performing One Cycle	*Name of Element*	*Symbol*
1. Move pedal downward to horizontal position (movement against spring tension)	Transport Loaded	TL
2. Change Direction at bottom of pedal stroke	Hold Down	HD
3. Move pedal upward. Release pressure of foot (tension spring pulls pedal and foot upward)	Transport Empty	TE
4. Change direction at top of pedal stroke	Hold Up	HU

The operators came to the laboratory twice. The first time they ran the series of pedals in one direction, and the second time they ran it in the other direction. For example, an operator would one day work the pedals in the following order: 1-2-3-4-5, and then on the second day they would reverse the order, and work the pedals: 5-4-3-2-1. Before an operator was tested, he was told to adjust his position and his chair so that he would be comfortable. The pedals were each operated with the right foot for a period of three minutes, and the operators were told to work as fast as they could. After one and one-half minutes of work, the kymograph was set into operation for approximately 75 cycles. After the 3-minute work period, the operator had a 3-minute rest period. Then a practice period for one-half minute on the next pedal, and another rest for one-half minute. At the end of this half-minute rest period the operator began another 3-minute work period. This procedure was carried through for all operators and on all pedals.

Data were taken from the paper tape which passed under the solenoid-operated pencils of the kymograph at the rate of 31.9 inches per second. The average value of both runs (from 1 to 5 and from 5 to 1) of the pedal was taken for each of the four phases of the pedal movement. The data for the fifteen operators were averaged. Table I gives the time for each element of the cycle for each pedal. The figure (left) shows it graphically.

It was found that the operators failed to complete more cycles in operating some pedals than in operating others. This may have been due to fatigue or to carelessness on the part of the operator in attempting to obtain greater speed. To have taken the completed cycles only would not have given the complete record. Therefore, the number of incomplete pedal strokes also was taken from the kymograph record.

The ratio of cycles completed to cycles attempted was: Pedal 1, 80.9; 2, 82.7, 3, 70.2; 4, 74.3; 5, 73.7.

Conclusions—Considering the five pedals studied and the conditions under which the study was made, the following conclusions may be stated:

1. Pedal 1 required the least time per stroke.

2. Pedal 2 required 5 percent more time per stroke than Pedal 1.

3. Pedal 3 required 6 percent more time per stroke than Pedal 1.

4. Pedal 4 required 34 percent more time per stroke than Pedal 1.

5. Pedal 5 required 9 percent more time per stroke than Pedal 1.

6. Considering the ratio of number of cycles completed to number of cycles attempted, Pedal 2 gave the highest ratio (82.7), Pedal 1 was next (80.9), and in order Pedal 4 (74.3), Pedal 5 (73.7), and Pedal 3 (70.2) gave the lowest ratio.

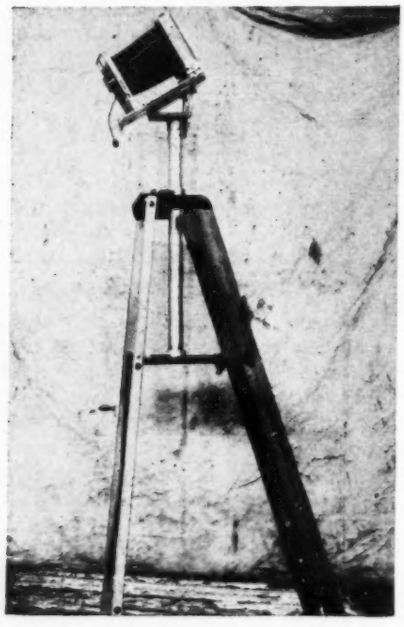
MANAGEMENT SHORTS

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary management accomplishments. Accepted articles will be paid for

Step-Ladder Tripod for Motion Study Shots

J. THEODORE GLEICK, Chicago

Need for elevating a camera for "top" shots has resulted in the arrangement shown in the accompanying picture. The head, removed from the studio tripod normally used, just fits snugly on a piece of 2-in. galvanized pipe. Brackets fastened to the top step and the bucket platform of the ladder form a holder in which the pipe may be quickly inserted. This arrangement not only provides a satisfactory camera support, but the ladder also enables the operator to reach the camera without hunting around for a chair or box.



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Special Stationery Will Save $5,000

J. M. DRULINER, Chief, Methods and Control, Vultee Aircraft, Inc., Nashville, Tenn.

By putting into effect an employee suggestion that we use a special letterhead and form for "rush" correspondence, we expect to save $5,000 a year on night letters, telegrams, and long-distance telephone calls. Imprinted around the edge of the stationery are the red and blue blocks used around airmail envelopes. Below the company heading in the center is the inscription, "Airmailogram."

The theory is that we can send a letter out on this stationery, written in brief telegram style, by airmail on the four-oclock plane which reaches such neighboring cities as Chicago, Washington, Cincinnati, and Detroit, in the evening. The company addressed receives the letter in the morning mail, first delivery. Psychologically, the effect on the recipient is practically the same as that produced when he receives a telegram or long-distance call—it impresses upon him the urgency of a quick reply.

There is little difference in service. If we sent a telegram at four oclock in the afternoon to one of our vendors for rush material, receipt of it that evening would not insure immediate action for they probably could not put through the order until the following morning (at which time they would have received the letter).

•

Explains Time Studies to Operators

G. G. MAYSTRIK, Mechanical-Industrial Engineer, Mergenthaler Linotype Co., Brooklyn, N. Y.

When over 1,000 machinists are employed to turn out approximately 4,000 different machine parts each year on a piecework

(*Continued on page 206*)

Management, How Good is Your Control?

Ask yourself these questions to check up

16. SAFETY

1. Do you watch out for safety hazards? Are you prompt in bringing them to the attention of the safety committee? Are steps taken immediately to correct them?

2. Are assemblers and other personnel protected from flying parts and particles from machines?

3. Do you require operators and helpers to wear safety goggles at all times? Do you also require the use of other safety clothing where necessary?

4. Have you instructed your personnel not to lift heavy loads without sufficient help? Do you inspect frequently to see that instructions are obeyed?

5. Do you prohibit the use of air hoses to clean assembly benches and work stands? Are you alert to correct violators?

6. Are machine foot pedals set up so as to eliminate danger of accidental movement?

7. Are your operators carefully trained to follow prescribed rules for starting, operating, and stopping machines? Are the rules posted conspicuously?

8. Are other employees instructed to not touch machine controls at any time, unless by your direction?

9. Are fire extinguishers accessible? Are aisles and working areas kept clear? Are dead areas behind machines and under racks and benches kept free from trash, etc.?

10. Are overhead racks, harnesses, or suspended parts securely fastened? Are floor boards nailed together properly? Kept dry and free of oil or grease?

11. Do you keep visitors out of your section and away from machines?

12. Do you inspect frequently to make certain that your men are following prescribed company safety rules and regulations?

Next Month: Parts Flow

Prepared by HARDING PALMER, *Industrial Engineer*

Lockheed Aircraft Corporation, Burbank, Calif.

MAINTENANCE SERVICES

SELECTION • INSTALLATION • INSPECTION • UPKEEP • ORGANIZATION

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FACTORY MANAGEMENT AND MAINTENANCE

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

MAINTENANCE as the Editors See It

No Rest for Maintenance This Year

MAINTENANCE HASN'T HAD MUCH TIME to go fishing during the past year or two. Since we are now actively at war, there will be less time than ever for play.

As it is now being fought, war is a struggle between machines—ships, tanks, planes—used in fantastic numbers. To produce them in unheard-of numbers, on a schedule that has been reduced from hours to minutes —such is the task confronting our industrial plants.

To maintenance falls the difficult but essential job of providing facilities needed for production, and keeping hard-pressed equipment of all kinds in top-speed service. That is a responsibility calculated to challenge the skill and ingenuity of any man. Difficulties of accomplishing the duties that fall to maintenance probably will be increased, rather than lessened, but they will be overcome in one way or another. Maintenance men are used to working against odds.

To do properly the job that is ahead of maintenance will require, nevertheless, skillful application of every resource of good management, technical knowledge, and Yankee ingenuity, 168 hours a week.

A hard year lies ahead of maintenance. The editors of FACTORY will do their utmost to help maintenance men serve their country by presenting the kinds of basic information that these men need most.

Order P-100 Raises Limit on Maintenance Supplies

HANDLING OF PREFERENCE RATINGS for repair and maintenance needs has again been speeded up, through Order P-100, recently issued.

In contrast to its predecessor, P-22, the new order recognizes that production has increased and will undergo further expansion. Therefore, a 10 percent increase over 1940 maintenance and repair levels is permitted. Special allowances will be made for plants working extra shifts, or overtime.

Small plants will also find that less bookkeeping is required. Restrictions on inventory and withdrawals, involving considerable paperwork, do not affect firms that order less than $5,000 worth of maintenance and repair materials per quarter. Heretofore the limit has been $2,500.

Suppliers, too, benefit by the new regulations. Formerly they were required to extend ratings at once on each order received, no matter how small. Now, when obtaining replacements made necessary by the prompt filling of maintenance and repair orders rated A-10, they may bunch their extensions and order in commercial quantities.

Procedure under Order P-100 is substantially the same as under P-22. Again there is the requirement that those who have the right to use this order certify that they are familiar with its terms.

Better be sure there is no misunderstanding about just what these terms are.

Keep Portable Electrical Equipment Safe

UNDER THE RIGHT CONDITIONS portable electrical equipment can be as dangerous, kill just as quickly, as a gun in the hands of a madman. With the widespread use of all kinds of current-consuming portable devices, from drills to trouble lights, it is easy to forget that even 110 volts can cause practically instant death. On the other hand, if the proper precautions are taken there need be little fear that the use of such equipment may endanger the operator.

High-grade portable tools are skillfully designed and ruggedly built. When new or in good condition they are as safe as human ingenuity and skill can make them. In service, however, they get pretty rough usage. Cords become frayed, parts work loose, coils ground. The time may come when a wire or other part touches the frame and raises its potential above ground. Then a dangerous condition exists, because passage of a very small current through the body may be sufficient to cause death. And it's well to remember that even slight shocks may cause serious injuries through falls brought about by the involuntary contraction of the muscles.

Maintenance should promptly discover and correct such conditions, but it doesn't always do so in time. There is often a tendency to keep portable, power-driven equipment in service so long as it appears to be functioning satisfactorily and no complaints are made. That is not a safe basis for determining whether or when electrically operated equipment needs attention.

Maintenance can insure prompt detection of defects by frequent and proper inspections. And do not forget that grounding gives the operator a high degree of protection. The Code requires it in hazardous locations and when the voltage is more than 150 volts; recommends it at lower voltages.

A little attention to the maintenance and safeguarding of portable electric equipment may easily prevent a deplorable accident.

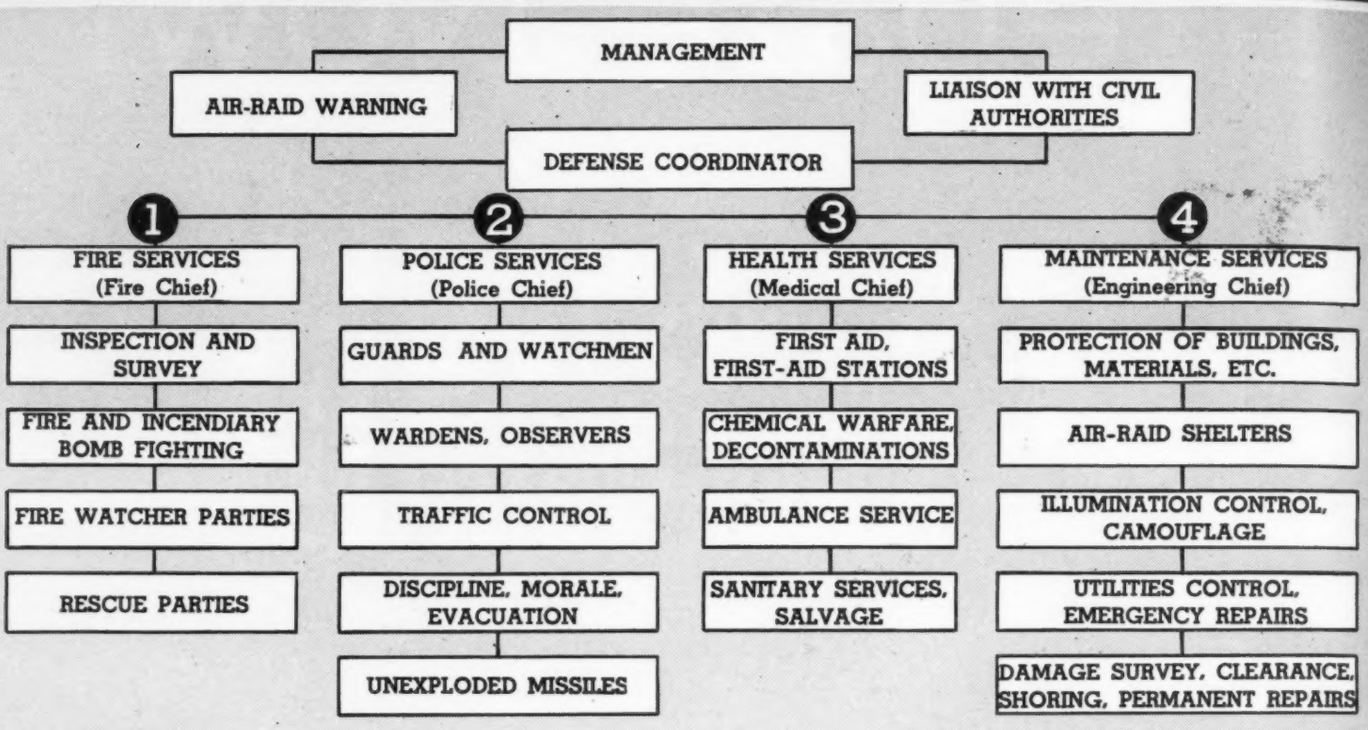
Prepare Now!

Providence Journal

Don't Wait for Bombs To Hit Your Plant

War. West Coast cities threatened. Washington deluged with requests for blackout information. Herewith *Factory* digests for plant operating men the plant protection recommendations of two government agencies—the Offices of Civilian Defense and for Emergency Management

HOW TO ORGANIZE



A PLANT-DEFENSE COORDINATOR must be a clear-thinking individual capable of taking charge in an emergency. He should have full responsibility for preparing plans, organizing and equipping squads, and training personnel. During an emergency he has control of the dispatching of all squads.

In the office of the plant-defense coordinator, provision must be made for communication with the civil air-raid-warning system, control of transportation facilities, and liaison with local governmental authorities.

He is to be made responsible for developing the communication systems within the plant to permit immediate transmission of messages between his office and squads organized under the various divisions, and between squads. The reporting center under the defense coordinator should have a system of reports from each squad and from each key position so that the coordinator will know when his plant is manned and ready. Check-off lists should be kept on hand.

All transportation equipment should be allotted by, and be under the control of, the defense coordinator.

Heads of the four divisions—fire, police, medical, maintenance—must be well qualified in their respective fields of work. They must be capable of managing men and of taking appropriate action under any conditions.

Squads are to be organized within each division to render the particular service for which that division is responsible. Usually a squad will consist of four or five individuals, or as many as the defense coordinator believes is necessary. Employees should be assigned to the types of protective work for which they are best suited.

Training of personnel should provide first for the training of individuals then of squads. Thereafter, the entire organization should be trained collectively to insure the fullest degree of teamwork and usefulness.

1. FIRE SERVICES

A competent fire-service organization consists of:

1. A main observation post with such additional observation posts as may be necessary to cover the area.

2. Protective fire-watcher posts with necessary men, equipment, and independent water supply; these posts should occupy an elevated position to cover local buildings with high fire risks, or buildings vital to production.

3. Fire posts conveniently situated but decentralized with equipment.

4. Adequate main and auxiliary water supply systems.

5. Fire squads organized and ready to deal with incendiary and high-explosive bombs and fires.

6. A direct communication system between fire-watcher posts, fire squads, and the headquarters of the plant fire chief so that reports may be made and assistance sent when necessary.

Fire-watcher squads must be organized, equipped, and trained. Their duties will be to watch for, locate, and handle incendiary bombs, but they should be prepared to call for assistance when necessary.

Rescue squads of specialists, such as engineers, carpenters, bricklayers, welders, shorers, and electricians should be organized, equipped, and trained to rescue people from damaged buildings. Their duties may be extended to include emergency handling of utility services. They must be able to work in silence, with hand signals. First-aid training is essential. These squads must be capable of acting quickly.

2. POLICE SERVICES

The plant police chief should be in charge of all police activities, the work of air-raid wardens and aircraft observers, training in gas defense and the wearing of protective devices. He is to have general responsibility for maintenance of discipline and for the development of morale.

The police chief supervises all squads and watchmen, is responsible for all persons entering the plant area, and is charged with safeguarding the plant from subversive activities as well as from theft. He controls all traffic and maintains a clear route to permit the necessary automobiles and rescue vehicles to reach the scene of an incident. Handling of all unexploded missiles, whether high-explosive or incendiary bombs, is one of his responsibilities. His men should be given special training for this work.

Under the plant police chief there is a senior air-raid warden in charge of all wardens and observers or plotters. Persons serving as wardens must be calm individuals with presence of mind who can act as advisers and guides to other employees. Wardens will be trained to work in conjunction with the local air-raid-warning system.

Observers should be placed on top of a substantially constructed building in order to command as extensive a view as possible of the surrounding buildings and areas. They will report the approach of planes, bombs dropping, fires, or any unusual incidents of which the senior warden should be informed.

Wardens will be prepared to handle the evacuation of employees from the plants to air-raid shelters. Each employee should be shown how to go by the most direct route from his working station to an air-raid shelter. He should go quickly and quietly.

Wardens will make certain that all lights are extinguished during a blackout, except those permitted to remain lighted for safety or other reasons.

3. HEALTH SERVICES

Plant medical services should be under the plant physician or a practicing physician. In addition to his regular training the medical chief should be qualified to handle poison-gas cases.

He is responsible for the organization of first-aid service and for the training of employees in such measures. So far as possible all employees should be trained in first aid. Conveniently situated first-aid stations in charge of trained workers are to be located throughout the plant area. These stations must be amply protected and equipped to render such treatment as is necessary until the injured person can be removed to a hospital. The ambulance service should be under the control of the plant medical chief. Only non-walking cases should be sent to hospitals by ambulance.

Sanitary services, from the collection of garbage to sewage disposal, must be watched carefully so that necessary steps can be taken to prevent disease and epidemics. The plant medical chief should consult with the local health authorities regarding emergency sanitary measures for protection of water and sewage systems, especially the elimination of cross-connections between safe and unsafe water supplies and other hazards.

Salvage of materials is necessary and important, but such materials should be treated before they can be used again. The medical chief is responsible for treatment of such materials and for the organization of squads to collect and handle them.

4. MAINTENANCE SERVICES

Maintenance services are under the engineering chief who must be a competent all-around engineer capable of acting coolly in all emergencies. His assistants are the technicians who deal with plant facilities, such as electricity, steam, gas, and water. Skilled workers, such as plumbers, pipefitters, machinists, welders, will be detailed to key positions, ready to do whatever is necessary.

The first duty of this division is to survey the plant and make all necessary preparations for the protection of buildings. Particular attention must be paid to the protection of all vital equipment, materials, and records. If permanent improvements cannot be made, temporary devices must be improvised immediately.

Air-raid shelters must be prepared for protection from both gas and bombs. Provision should be made for serving hot tea or coffee, and light refreshments, and for proper lighting, heating, and ventilation.

Control of illumination during blackouts or emergencies must be studied. Means must be developed to control quickly all artificial illumination so that no light will be visible externally during a blackout.

Tied in with illumination control is the matter of camouflage by day wherein conspicuous objects are painted so that they will harmonize with the background and thus be concealed from view, particularly from an airplane. Any scheme of camouflage should be studied from the air by experts; otherwise the opposite effect from that desired may be produced.

Key men are to be stationed in pairs at the various utility controls, such as telephone switchboards, gas, steam and water valves, and boilers. These men must remain at their posts during an air raid to be ready to handle any emergency at that post.

Repair crews must be ready to handle any emergency anywhere. These emergency-repair squads are to be composed of men skilled in their regular tasks who can work quickly and efficiently under even the most adverse conditions.

Immediately after an air attack a survey of the plant must be made so that any dangerous walls or foundations can be shored up or demolished, debris removed, and conditions restored to normal as rapidly as possible. Make permanent repairs afterward.

HOW TO MINIMIZE

WHEN A BOMB FALLS on a building the effect produced depends on several factors, including type and construction of the building, kind and size of bomb, and angle of impact. The resultant damage can be classified into primary and secondary effects.

Primary damage is the direct result of the impact and explosion of the bomb. It results in damage to structural elements, such as concrete, brick or stone walls, concrete or steel beams, and partitions, roofing materials, windows. The secondary effect results indirectly from primary effects and includes the collapse of structures whose members have been destroyed by the explosion or displaced by the blast, or when falling debris has heavily overloaded undamaged members.

The extent of confinement or obstruction of the blast wave plays an important role in determining the interior damage caused by an exploding bomb. In the immediate vicinity of the bomb, the pressure wave tends to destroy walls by pushing them away from the explosion, while at a greater distance either pressure or suction, or both, will cause partitions and windows to collapse toward the explosion.

Bomb fragments ordinarily do not affect the structural stability of the building, but if a bomb explodes close to concrete beams or columns the damage may be quite severe. Pieces of concrete may be broken away, exposing the reinforcing. Fragments may pierce ordinary partitions and walls, as well as light roof coverings and windows.

Structural damage from earth shock may be more serious than that resulting from blasts alone. Buildings with masonry and brick load-carrying walls may be badly damaged by earth shock. Bearing walls are stable under the loads for which they were designed, but when subjected to heavy lateral loads, such as may be produced by earth shock, they usually collapse. The bomb must penetrate the earth and explode underground, however, before causing damage by earth shock.

Considering all the effects produced by the impact and explosion of bombs, it is found that steel-frame structures are much more resistant to collapse than any other type. Even a single important member of a frame is difficult to destroy by a bomb, except by direct impact or when the explosion is in contact with the member. A near miss simply scars the steel with fragments and perhaps displaces it by a few inches. The most serious effect results when a bomb bursts in the floor and displaces the base of a column. In such instances the damage may be widespread.

Buildings whose walls support the floors and roofs suffer the greatest damage. Considerable lengths of such walls are readily destroyed by direct hits or near misses. As a result floors or roofs collapse, and the structure usually must be rebuilt. If brick walls are bonded to light steel columns, the result may be to distort the column as well as destroy the walls.

Above Ground Level

If a bomb explodes above ground level, further damage may be caused by collapse of the floors and walls beneath, due to the load of debris.

How much damage may be caused to the interior of industrial plants depends largely on whether they are of single-story or of multistory type. With a single-story industrial building a bomb may burst either on the roof or on the ground. The chief damage from bombs bursting on the roof is from bomb fragments projected downward and from the dislocation or destruction of roof trusses or girders. When a bomb bursts on or in the ground, machinery is likely to be displaced and wrecked.

In multistory buildings a bomb may explode either in the top story or penetrate two or three floors before it explodes. When a bomb explodes between floors, the degree of confinement of the explosion plays a very large part in determining the amount of structural damage.

For example, in very large structures with uninterrupted floor areas and high clearances the explosion takes place in what is virtually free air and it may do little or no structural damage.

WHAT KINDS OF BOMBS?

1. DEMOLITION BOMBS. Weight from 50 to 4,000 pounds. Designed to destroy buildings and other structures. European experience shows most bombs dropped on cities have not weighed more than 550 pounds apiece

2. FRAGMENTATION BOMBS. Weight about 17 to 30 pounds. Directed chiefly against personnel or targets damaged easily by fragments

3. GAS BOMBS. Much smaller than demolition bombs; effect on structures is less severe

4. INCENDIARY BOMBS. Weight varies from 2 to 100 pounds. Generally made of magnesium and contain oil or thermit

5. ARMOR-PIERCING BOMBS. Designed for maximum penetration, carry a smaller proportion of explosive than demolition bombs. Used primarily against highly resistant targets

6. AERIAL MINES. Weigh about 2,000 pounds apiece and are similar to submarine mines. Released on a parachute, they explode on contact and produce an intense blast

During an aerial attack, machine-gun and cannon fire may also be employed. Structures designed to give protection against bomb splinters are likely to be immune to machine-gun fire. Effect of aerial gunfire on buildings is slight compared with the damage that may be caused by bombs. Anti-aircraft shell fragments usually fall from considerable heights and can cause injury to exposed personnel and damage roofs, skylights, and windows

At the other extreme, bombs bursting in small rooms may completely disintegrate walls and ceilings.

Protective barricades and flexural reinforcements have been used quite successfully by the British in minimizing extensive destruction. Where exterior walls are subject to easy rupture, either by flying fragments or otherwise, barricades may be erected to lessen the damage. To provide protection where there are extensive window areas which contain large panes of glass, inclined timbers or shores are erected from the ground to a distance of perhaps 30 feet up the side of the building and covered with planking, outside of which a covering of sandbags is usually placed. Resistance of sand to penetration by fragments is high; it is very effective, therefore, in warding off damage to the building.

Where walls are sufficiently thick and windows are not too numerous or too large, the window area may be boarded up both inside and out, and the space between filled up with sand. This expedient provides reasonable protection in exposed places.

Reinforcement of structural members should follow the general pattern of tying the beams or girders together over each column so that if a column is dislodged two adjacent beams will act as a single span without excessive or dangerous deflection, so that a new column may be quickly put in place.

Another method that may be used to strengthen the building, if space allows, is to put in secondary timber struts so as to increase the number of columns in a building. Wherever possible each pair of adjacent beams should be checked for reinforcement in the event of the loss of a column. Supporting walls should be shored against easy collapse. In wood, splice plates and trussing will aid in this reinforcement. Exposed steel members may be reinforced over columns and welded to make them continuous. Reinforced concrete beams can be strengthened by splicing steel reinforcing plates on their sides, over each column. Structural steel incased in concrete can be handled similarly. If steel beams are covered with brick, tile, or plaster, these materials may be removed and the beams strengthened as suggested before.

To minimize possible damage by fire, make sure that there are a sufficient number of shut-offs for all gas and power lines, and enough bypasses and valves for water lines to make sure that progress of fires, due to the rupture of any of these vulnerable services, is kept to the minimum.

Storage of highly flammable materials, such as gasoline, oil, or chemicals in tanks, needs special consideration on account of the serious fire risk. Protective measures may involve the construction of dikes around tanks, placement of tanks underground or in a less dangerous location.

Communications must be maintained for emergency service. Duplication of lines and location of telephones in shelters and first-aid stations are necessary for adequate control.

Usually sandbags will afford the simplest and most effective means of protecting essential machinery against fragments. Wooden boxes filled with sand are a good substitute.

Girl workers in this British factory are only a few steps from the brick and concrete shelter at the right. When an alarm sounds they don fiber helmets, keep production going, wait for the "take cover" signal

Pierce Light Roofs

Incendiary bombs may be expected to pierce light roofs and burn on the floor of the top story. Most modern industrial buildings are of steel or concrete construction and consequently are less vulnerable to fire, but the contents of many such buildings are highly flammable. It is important, therefore, to take all possible steps to reduce the risk of fire by having adequate portable firefighting equipment in addition to permanent installations, which may be damaged. Reserve supplies of water should be provided.

It is advisable to study the problem of carrying on work if supplies of water, electricity, and gas from public or private sources are interrupted by damage to producing stations or service mains. Auxiliary power plants ready for immediate use are the answer to this problem. Duplication of power and communication lines, and switchboards, is desirable.

RIVER ROUGE PLANT—Before Blackout . . . . .

HOW TO BLACKOUT

BLACKOUTS are an important defense measure. The purpose of a blackout is to deprive enemy airmen, as completely as possible, of reference points and distinguishing marks that may help them when an attack is made.

In blacking-out plants producing war materials or other essential products the proper balance must be struck between two important objectives: (1) The safety of personnel and plants; (2) maintenance of production at as high a rate as possible. Therefore, details of the restrictions that are to be placed on lighting are largely a matter that has to be worked out in detail by each plant, in consultation with local defense authorities.

In general, all illuminated billboards or signs and all external lights, except those expressly authorized by proper authorities, must be turned off. Roads and pathways are to be marked by guide stakes, white posts, or stones.

Surfaces that reflect light may be more difficult to control than primary light sources. The effectiveness of completely blacking out the lights in a plant may be appreciably lessened by the reflections of fires and other light sources from windows or roof glazing. Painting or otherwise covering such surfaces is the answer.

Tin roofs, water tanks painted with aluminum or light-colored paint, and other light surfaces may also reflect light to an objectionable extent. They should be given a dark, matt finish.

Where necessary, a separate system of low-intensity pilot lights should be installed to enable key men to tend vital plant machinery in a blackout and enable personnel to reach shelters in safety when the regular lighting is extinguished. Signs made with luminous paint are a useful expedient.

Paint for Windows

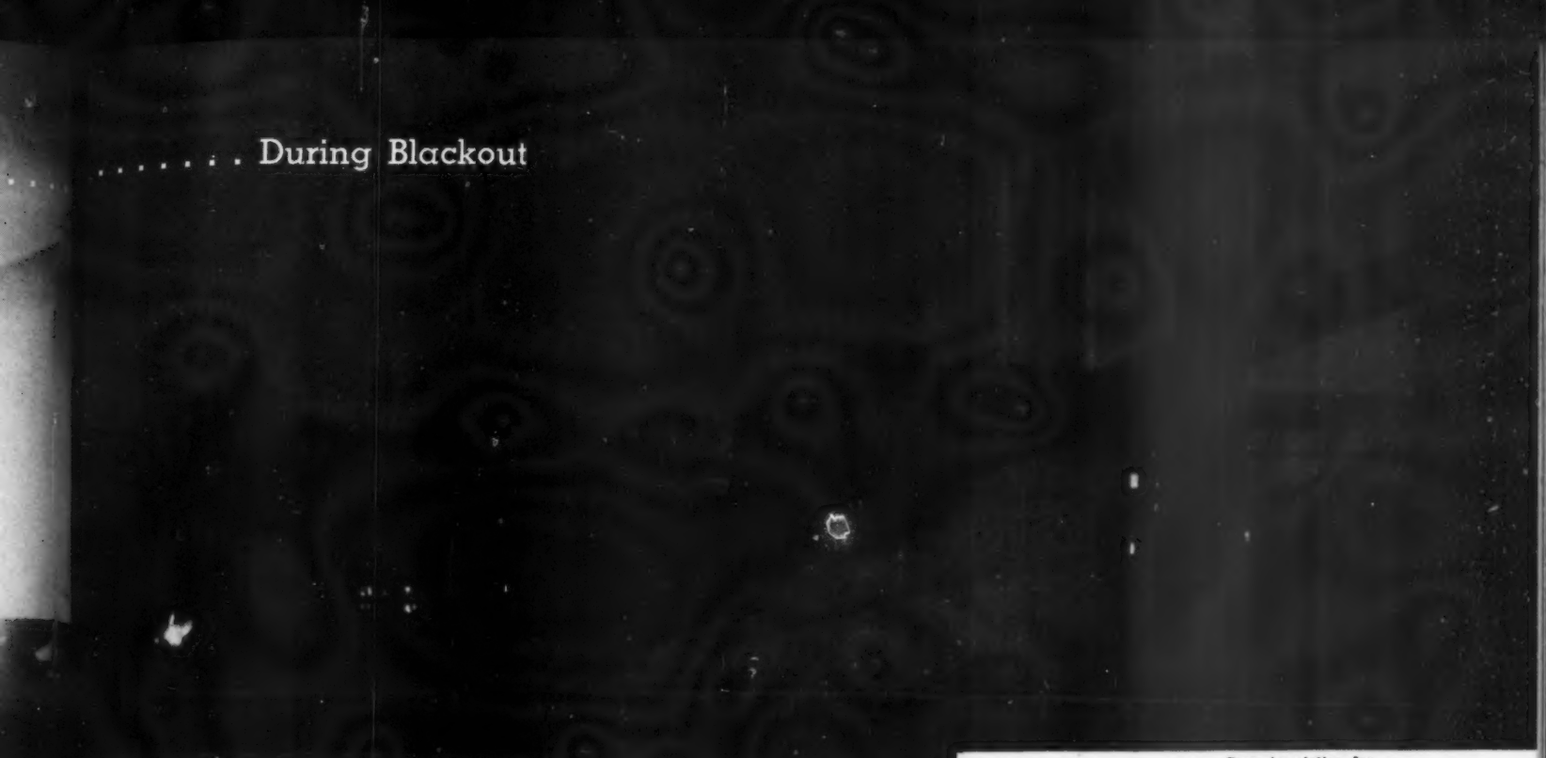
Where complete blackout is required, windows, skylights, and glazed doors must be rendered opaque at night either by the use of paint covering the whole window, by the fitting of screens, or by a combination of both methods.

The problem of preventing passage of light through windows and skylights is closely related to the effect of blasts and splinters on glazing. Effects of blasts from high-explosive bombs cannot be predicted with certainty. It would be safe to assume that all windows and roof glass would soon be blown out under protracted aerial bombardment. Falling glass is an ever-

Four Steps in Blacking Out

1. Turn off all exterior lights. Paint reflective exterior building surfaces
2. Provide local lighting for machines, to maintain production where total blackout is not required
3. Install low-intensity pilot lights to prevent accidents, permit manning of key posts
4. For complete blackout, obscure all glazing with paint or screens, or both

T THE PLANT



Press Association, Inc.

Obscuring the many sources of light in Ford's Rouge plant, during a recent test blackout, was not an easy task. Considering the difficulties, good success attended this first attempt to blot out all light sources

present danger that must be dealt with if work is to continue during a raid. Windows in key positions can be maintained much longer if glazed with reinforced glass or plastic materials.

The simplest way of blacking-out is to spray on paint internally or externally. Paint used for this purpose must be waterproof and sufficiently opaque in one coat. Since the cost of removing ordinary paint may be several times the cost of applying it, any paint used should be easily removable.

Use of paint on existing glass may prove to be a very expensive expedient, however, since the damage bound to result to glass in a bombardment will necessitate extinguishing all lights until the glass has been replaced. In any event, to prevent danger from flying glass splinters it is desirable to install close-mesh galvanized-wire netting and cloth on frame.

It is usually desirable to obscure light by shutters of materials such as plyboard, composition board, or wood covered with a waterproof material that will obscure light, prevent broken glass from flying into the room, and be weatherproof when window panes are broken. Frame shutters that can be taken down during the day, and also be made gasproof and applied inside the window, are an advantage.

Cotton and sacking can be made grease-, water-, and germproof by impregnating them in a cellulose solution, and will not be damaged by mustard gas or when boiled for decontamination. Plain fabric suitable for strengthening window glass can be obtained in various colors, preferably dark green or black, and may be glued to the glass with ordinary adhesives or stretched on frames.

Light-Obscuring Screens

An inexpensive gas-protective and light-obscuring screen for vertical windows consists of rubberized or treated cotton fabric tacked at the ends of two wooden uprights which are wedged in position between the horizontal members of the window frame. During the day the screen can be taken out and stored. When wedged into position it is sufficiently loose to yield under blast pressure and therefore is likely to last much longer than a fixed screen.

Lightproof paper screens on batten frames also are inexpensive and effective. For this purpose lightproof paper or six-ply brown kraft paper may be used.

A sliding tray that enables skylights to be blacked out quickly and gives protection against flying splinters of glass consists of simple shutters that slide on rods and are pulled to one side by a wire. A number of shutters can be opened or closed in a row.

Where it is possible to get at the roof glazing conveniently from the outside, glass from alternate bays may be removed and stored for emergency repairs. In its place painted panels of ¼-in. fiberboard are installed. In this way 50 percent of the light will be permanently shut off. The obscured portions of the glazing can serve in the daytime as storage places for the boards placed over the remaining glass at night or during a blackout.

Clipping an additional light steel T-section to glazing bars provides a simple method of holding fiberboard coverings for roof glazing and windows. The slotted T-sections are permanently fixed in position by means of special clips and left until it is necessary to obscure the light. Opaque boards can then be fixed in a short time by means of wedges.

For blacking out sawtooth roofs from the inside of the building fiberboard shutters, which may be camouflaged if desired, may be fastened to a hinge on one side of the valley gutter so as to lie on the sloping portion of the roof during the day and be pulled over the roof glazing at night.

Further details of some of the methods and devices that have been developed for blacking-out window and roof glazing will be found in the publication, *Blackouts*, issued by the Office of Civilian Defense. This publication can be obtained from the Superintendent of Documents, Washington; price, 25 cents.

WHAT SHELTER

PROVISION of adequate air-raid shelters is a prime necessity. Since steel or concrete-frame buildings are relatively safe from anything but a direct hit by high-explosive bombs, the convenience and economy of a shelter inside a building may be determining factors in selecting the location of a refuge. Shelters within buildings are easily accessible, and can be kept warm and livable. With few exceptions, modern factory buildings more than four stories high are of reinforced-concrete or steel-frame construction, and offer suitable and accessible locations for shelter.

The ceiling of a room selected for a refuge should be strengthened to support any debris load imposed on it. Lateral protection may be obtained by closing up windows and door openings with concrete, brick, or, in an emergency, with sandbags. The room should preferably be free from gas or steam pipes.

The amount of bracing necessary to withstand debris loads is quite large. British and German specifications require strengthening to carry a load of 200 to 400 pounds per square foot in masonry buildings.

Suited for Refuge

Basements in some buildings are particularly suited for refuge rooms. They offer the greatest lateral protection from blast and splinters, and the floor or floors overhead may afford protection from light bombs. Disadvantages are that the weight of debris is likely to be greatest on the basement, and there is danger from heavy gas collecting in low spots. Water and sewer mains bursting nearby constitute another danger. The possibility of fire in buildings of non-fireproof construction must also be borne in mind. The decision as to whether the basement should be used as a shelter must be made only after consideration of all factors present.

In some steel or concrete-frame buildings the intermediate floors, such as the second or third floors in an eight-story building, are well suited for shelter. Floors at intermediate levels have the important advantage of being generally above the level of gases, and the danger from splinters is decreased. The weight of material overhead is not so great as it would be over a basement location; hence less shoring up of the ceiling is necessary. In the event of a direct hit the bomb may explode on the roof or pass through to the basement, leaving the shelter comparatively undamaged. The danger of being trapped in the shelter would probably be less than in a basement structure.

In a British aircraft plant workers are protected from bomb fragments by interior brick walls that prevent the fragments from sweeping across large areas. Such a wall can be seen in the background

In a large building it is preferable to build several small shelters in preference to one large one. Entrance and egress will be facilitated and total loss of life prevented if one shelter is hit. Shelters may advantageously be located in corridors.

Shelters in basements should have at least one emergency exit that does not open into the building. A tunnel leading from the shelter room to a manhole some distance from the building will answer this requirement satisfactorily. A window that has been closed up by sandbags or loose brick can also be a means of escape. It occasionally happens that separate buildings of a single organization are connected by utility tunnels. These tunnels may afford emergency exits and can be used even as shelters, where sufficient cover exists and steam, gas, and other lines can be shut off.

Use of existing buildings for shelter purposes may, of course, be impracticable, inconvenient, or even impossible. Old buildings of poor construction, say, are worse than no buildings at all.

External shelters may be built in the form of long narrow tunnels or large rectangular buildings. They may be above ground, partly buried, or placed many feet underground. They may be designed to give almost any degree of protection considered necessary. Design of underground shelters is a technical problem, however, that cannot be discussed in detail here. A number of suggested designs are embodied in the publication, *Protective Construction, Bulletin No. 1*, issued by the Division of State and Local Cooperation, Office for Emergency Management. This publication can be obtained from the Superintendent of Documents, Washington; price, 25 cents.

MAINTENANCE

A flying squadron of skilled repairmen is on its way with all the tools and parts needed, a few minutes after an emergency call comes in

Keeps 'Em Coming

An adequate force of maintenance men permanently assigned to each key department, with a large group centrally located, ready for emergencies anywhere—that's how maintenance is set up at this plant

R. P. McBRIDE, Plant Engineer, American Car and Foundry Company, Berwick, Pa.

PREVENT EMERGENCIES as much as possible, and be ready at all times to handle those you can't prevent. That is the basic philosophy underlying the organization of all maintenance departments in the American Car and Foundry Company's various plants. This way of looking at the problem is, in turn, a natural consequence of our conviction that the most important function of maintenance is to insure continuity of production. There are other very important functions, to be sure, but we put this one at the top.

At Berwick A.C.F.'s maintenance department has to take care of a plant whose grounds contain 145 acres. Of this area, 46 acres are under roof. At present we have 254 major buildings,

An endless stream of 13-ton light combat tanks rolls off the Berwick assembly floor, and out into the country for a road test

and about 50 other outside structures such as water tanks, traveling cranes, and small buildings used for one purpose or another. To connect and serve the main buildings and storage yards requires 21 miles of standard-gage railroad track, five steam locomotives, and 250 freight cars. Three locomotive type cranes—two steam and one diesel-driven—are kept busy handling miscellaneous bulk material. In addition, 37 gasoline-driven tractors, about a thousand trailers, and 12 automobile trucks are used to handle parts and materials in and between buildings.

Some idea of the size of the piping systems needed to supply the services required in the plant may be obtained from the fact that we have 25 miles of overhead water piping alone, with another 12 miles underground.

The plant is primarily engaged in the fabrication and erection of all kinds of railroad equipment, and also has an extensive metalworking department involving such operations as rolling bars and flat stock, forging, casting, and all manner of machine work. More than 4,000 motors are required to drive the various machine tools and other equipment. These motors range from fractional to 600-hp. rating. Altogether they impose a connected load in excess of 23,000 horsepower.

Forty-five overhead cranes and a large number of stationary and monorail hoists are required by the 20 major departments into which the plant is divided. Most of these departments are operated two or three shifts a day, since a large proportion of our facilities is devoted to the production of army tanks and other defense needs, and the remainder of our output comprises essential items.

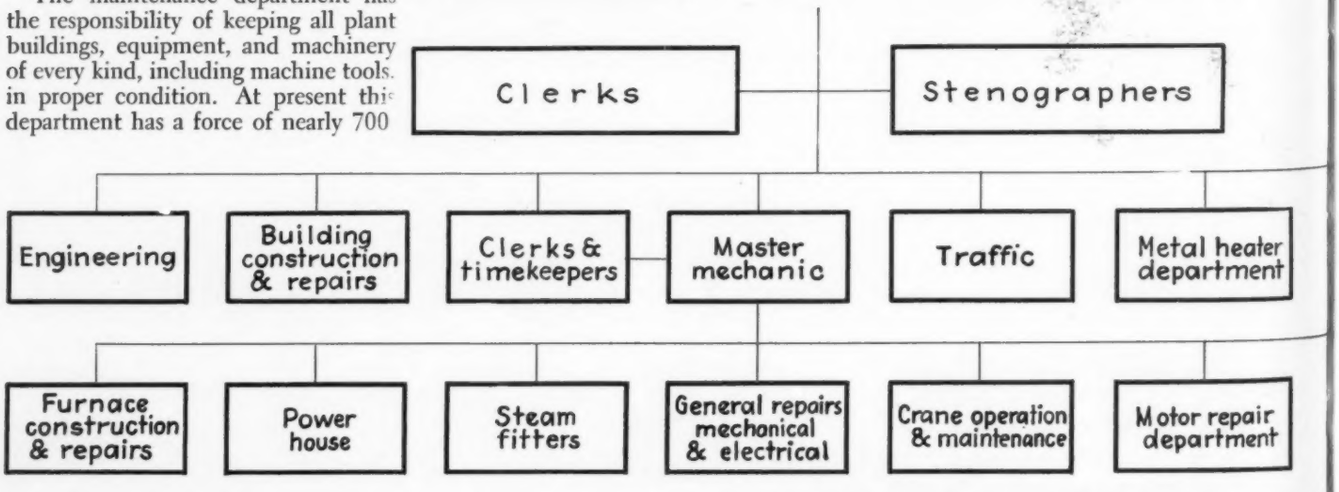
The maintenance department has the responsibility of keeping all plant buildings, equipment, and machinery of every kind, including machine tools, in proper condition. At present this department has a force of nearly 700 which includes 33 foremen, draftsmen, engineers, and clerks. About 200 tradesmen, mostly carpenters, and a small number of foremen are engaged in erecting several new buildings. When the current building program is completed it is estimated that a force of approximately 500 men will be able to handle the normal work of the maintenance department in this plant, where approximately 7,000 men are employed.

How the department is organized and responsibilities are delegated is shown in the accompanying chart.

In view of the size of our plant and the distance between buildings, it would hardly be feasible to station all the maintenance men at one point. Too much time would be lost in traveling around the plant, and it would be impossible to handle emergencies as quickly as they should be. Therefore, the force is split up into a number of groups.

The maintenance building, which is a large single-story structure, contains the electrical, pipefitting, sheet metal, carpenter, and other shops. These shops or departments contain all the kinds of equipment required by the respective trades. A daytime force of 207 men is normally required to handle the work done in the shops.

RAY P. McBRIDE attended Drexel Institute and LaFayette College. After a long period of service with A.C.F. he's still studying. When times were less hectic he relaxed by delving into the history of his community. Outsmarting trout and bass also took up part of his spare time. These diversions have now been put aside for the duration. Heading up the maintenance department at Berwick is a full-time job



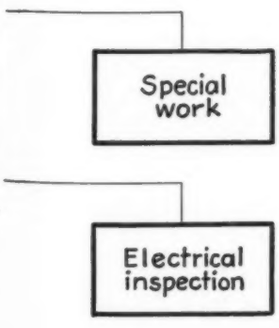
These men also constitute a reserve force or flying squad that can be quickly dispatched with any needed equipment to any part of the plant where a serious breakdown or emergency has occurred. Tractors are always available for hauling trucks loaded with electrical instruments, chain falls, welding and cutting tools, or anything else that may be needed.

The remainder of the daytime force, except men working on new construction, is assigned permanently to 20 major departments in groups ranging from 2 to 12 men. When only two men are needed, one of those assigned is an electrician and the other a mechanic having plenty of experience with the kind of equipment in the department to which he is sent.

With the exception of the two-man groups, these resident maintenance men work under the direction of a squad leader. Their sole duty is to keep all the machinery in the department running. To do so they must inspect it at frequent intervals, promptly make any adjustments or repairs needed, and in general do everything they can to minimize delays.

When an emergency arises that is beyond their ability to handle, the squad leader promptly notifies the master mechanic by telephone, reporting the nature of the trouble and the kind of assistance needed. The master mechanic then makes up an emergency squad from the men in the maintenance shop and dispatches it to the department in trouble.

In order to keep a check on the performance of equipment and the work of the resident maintenance men, the leader of each squad is required to send a report to the master mechanic showing the causes of any delays and the equipment involved, during his shift. A similar report is made out by the head of each production department and sent to the district manager, in charge of the Berwick plant. A copy of this report is sent to the plant engineer and compared with that rendered by the maintenance squad leader. Any discrepancies or omissions are immediately investigated.



Proper conduct of the maintenance department requires that we keep a good many records of one kind or another. One of the most valuable is our equipment record. A card giving all pertinent data is made out for every machine and piece of equipment that comes into the plant. The nature and cost of all repairs made to this equipment are also entered on the card.

We watch these cards closely because from them we are able to detect any makes or types of equipment that require excessive maintenance or do not perform satisfactorily. These deficiencies may, of course, be due to overloading or abuse. Therefore these possibilities are carefully investigated, and if they are found to be the cause of the trouble, appropriate measures are taken to remove the cause. Through these cards we have discovered and corrected a good many instances of overloading.

It was mentioned previously that most of our departments run on a two- or three-shift basis. Such departments have resident maintenance men assigned to them for the night shift, and in general the maintenance department serves them in the same way as during the day shift, although the total night maintenance force is smaller than that on the day shift.

All important motors, controls, machines, and other items are under practically constant scrutiny by the resident maintenance men. At regular intervals, whose frequency is determined by experience, all equipment is given a comprehensive checkup to determine its condition and the nature of repairs needed to put it in first-class shape.

Special Reports

In order to keep a close watch on the condition of some important items of equipment, as well as various operating costs, 46 special reports are prepared for the plant engineer. These reports are made up at intervals ranging from daily to annually. Preparation of these reports is a definite, permanent obligation placed on the division head responsible for getting them out.

Since we have to inspect and maintain thousands of pieces of equipment, and do countless other tasks, both regular and special, it would be only human if some of these jobs were overlooked or forgotten in the absence of some system for reminding us what is to be done and checking up on performance.

A card file serves as a reminder for some of the things we must do. In this file there is a card for every important job that has to be done periodically, although usually at rather infrequent intervals, by the maintenance department. On the first day of every month there is sent to each division head in the maintenance department a memorandum that reminds him to do certain important jobs, together with the date on which the work should be completed. Typical reminders over a period of a year:

Inspect dust arresters
Inspect all roofs and structural steel
Check condition of concrete roadways
Inspect all lightning arresters and high-tension switches
Inspect and oil office fans
Put up awnings
Inspect and oil all firedoors
Stencil approved pressures on all air receivers
Check all steam traps
Check thermostat settings in dry valve houses

Some of these jobs obviously must be done in the spring or autumn, say, to prepare the plant for the coming season. Others must be done semiannually or oftener, in order to keep the equipment safe and in good operating condition.

Progress in the execution of these and other jobs is reported at a meeting of all executive personnel of the maintenance department held every two weeks. Aside from providing a convenient way of checking the progress of work, these meetings are very helpful in several ways. For example, each division head gets a better understanding of the problems and difficulties confronting the other fellow. That promotes better cooperation among the different divisions. Also, a word from those who need help on some problem will put at their disposal the collective experience and knowledge of the entire group. Less waste of time and money, higher efficiency, and better results all around in conducting the work of the maintenance department follow as a matter of course.

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Rubber is a vital war material. Our country's supply is threatened. It is every plant man's duty to insure maximum life from all rubber products

Make Rubber Belts Last Longer

PAUL D. SULOFF, Mechanical Goods Development, The Goodyear Tire & Rubber Co., Akron

Figure 1. These cracks in the pulley ply of a belt were caused by oil swelling the rubber compound, with resultant distortion of the plies

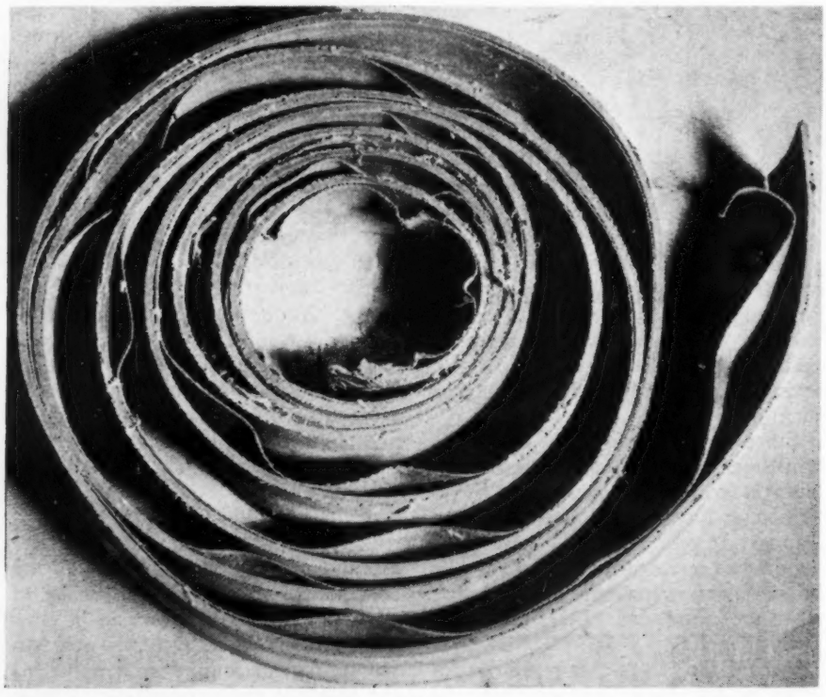

Figure 2. Oil reduces the flexing life, may cause separation of plies

How seriously tension and other factors affect the life of rubber belts was explained in the preceding article, in December. Here are some other elements that are highly important in determining the service life.

Elimination of fasteners by the use of endless belts where feasible is to be desired, but there are a large number of fixed-center drives, to which it is not practicable to apply endless belts. Such drives make up the major portion of the transmission belt field. Therefore, the selection, installation, and maintenance of fasteners are important factors in the conservation of belting.

Selection of the proper type of fastener is likely to be the most troublesome job, since most manufacturers make a single type that is suitable for some, but not all, drives. Plates and rivets, or plates with integral clinching teeth, may be used on practically all drives where only one side of the belt runs against the pulley. In the larger drives of this type, heavier plates with countersunk bolts have won acceptance. For drives where both sides of the belt run against the pulleys, the flush-hinge types of fasteners are required, for obvious reasons.

Proper Size

Selection of the proper size of fastener for the belt thickness and pulley size also is important. Fasteners that are too large may break the belt at the back of the fastener, whereas those that are too small may open up or pull bodily out through the fabric of the belt. Many maintenance men never look at belt fasteners after installation until failure takes place, which may result in the destruction of belting.

Bolted fasteners require tightening, in particular shortly after installation. Riveted plates require replacement of rivets from which the clinched portion on the pulley side has become worn

or broken off. In time hinged fasteners need new hinge or rocker pins, while the wire lacings themselves may wear through or break at the point where they bend to pass through the belt.

Failure to take care of such matters as these may let a portion of the fastener pull out and cause the belt to rip longitudinally, or batter up the ends so badly that refastening is made absolutely impossible.

Installing Fasteners

Installation of fasteners, of course, requires square, accurate cutting of belt ends; accurate location and punching of bolt holes; adequate tightening and later retightening of bolts; proper driving and clinching of rivets or prongs; insertion of rocker pins so that rocking actually takes place; and proper setting of flush-type fasteners down into the belt surface so that repeated blows against the pulley do not destroy the fastener.

Practically all oils, including those of vegetable origin such as castor oil, are seriously detrimental to natural rubber compounds. The oil acts first to swell the rubber compound, which distorts the shape of the belt and places some plies in positions where they must soon be broken up. Figure 1 shows a belt surface that has broken up in this way. A further effect of the oil is to reduce greatly the flexing life of the belt, in some instances resulting in separation of plies. Figure 2 shows this condition.

Some wide, thin belts that have been exposed to oil on one surface only assume a convex shape away from the oil-swelled surface to such an extent that they cannot be used. Large amounts of oil are not necessary to produce such failures. Minute quantities picked up at each revolution of the belt or pulley or at any regular interval, are retained by the belt and build up to a serious amount. On cotton mill spinning frame drives, records of service vary roughly from one year to eight years on drives that would normally be called identical. Inspection of early failures shows, almost invariably, an oil-soaked condition and the type of failure shown by the illustrations on these pages.

Synthetic rubber belts have been introduced to a limited extent for use on drives subject to oil but use of this material in belting is still in the development stage and at present it is available only in limited quantities.

Some liquid belt dressings are oil, as far as rubber belts are concerned, because they improve the coefficient of friction or grip only at the expense of the rubber in the belt. The action of such dressings is to swell and soften the surface rubber into a tacky mass. This is not a permanent condition and later applications of dressing find less and less rubber on the surface to combine with. At the same time deterioration of the friction between plies is bringing on the conditions shown previously.

One dressing recently tested was found to be mainly oil of one sort or another, and a sample of rubber compound immersed in it swelled 138 percent in 24 hours.

As a simple test of any liquid dressing, immerse the loop of a rubber band in it for 24 hours. If the rubber swells badly it is reasonable to expect that the general effect on rubber belting will be detrimental. If there is any doubt about the nature of the dressing being used, ask the manufacturer of the belting for his opinion and his recommendations.

There is ordinarily not much opportunity to control the ambient temperature of belt drives, but it is well to keep in mind that increased temperature is one of the things that reduces rubber belt life sharply.

Common Abuse

Edge wear is possibly the most common form of mechanical abuse. Wear on edges loosens and pulls out the edge yarns of the duck, which eventually narrows the belt. In the meantime fragments of cotton are thrown off the belt, possibly into processes where they are distinctly unwanted. It should not be necessary for the edge of a belt to rub continuously except possibly on cone pulleys. Figure 3 shows edge wear on a cord belt.

Keep shafts parallel and pulleys in line, and avoid trying to hold belts on the pulleys by force applied to edges.

Lumps of dressing and dirt building up, particularly on small pulleys, produce a local bending of greater than normal severity and create an uneven distribution of tension in the fabric across the belt width. This combination can cause cracks in the outer surface or loosen the pulley ply.

Pulley and belt surfaces should be kept clean and free of lumps. Ordinarily the belt takes care of this itself, but in some instances a combination of dressing and dirt builds lumps that remain for long periods.

Excessive crown or improper proportion of belt width to thickness may subject belts to excessive tension and face pressure in the center portion while the edges stand free of the pulley. Less crown and narrower, thicker belts are the remedies for this condition, which soon leads to trouble.

Figure 3. Letting the edge of a cord belt rub causes premature failure. Edge wear is one of the most common forms of mechanical abuse

Crown conformation and ideal flex life demand opposing belt proportions in that wide, thin belts are desirable from a flexing standpoint while narrow, thick belts conform better to highly crowned pulley surfaces. Therefore, a compromise is required, which will usually be dictated by pulley size.

In pointing out here some of the hazards to rubber belting the impression may be left that this is a delicate and vulnerable item of power transmission equipment. Nothing could be more untrue, as numerous life records of rubber and fabric transmission belt will testify. A belt record shows that one belt is still in service after thirteen years, during which it has traveled some four million miles.

Notwithstanding such records, there is unlimited opportunity for improving belt life, which in turn will contribute to the conservation of rubber, a reserve supply of which must be built up.

Before You Reapply Controls

Changing a motor controller from the original application to another isn't just a matter of making a few connections. Voltage, power requirements, frequency, phases must be matched. Sometimes controllers can be altered to fit, sometimes not

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SEVERAL POINTS must be checked before motor controllers are changed from one application to another, or taken from the storeroom and put back into service. It is probably well known that a.c. controllers cannot be used on d.c. circuits, and vice versa. But what about changes in voltage or frequency? Since a controller usually consists of a number of mechanical and electrical parts, it is frequently possible to adapt it to the new operating conditions.

First, let us consider d.c. controllers. With such controllers only the voltage needs to be considered. (It is assumed, of course, that the controller is of suitable type for the application.)

If power requirements are assumed to be the same, a change in voltage involves a change in line currents. If the voltage is lower than it was originally, line current will be higher. If voltage is increased, line current will be decreased. In general, current and voltage change in the inverse ratio. If the voltage is reduced to one-half the original value, the current will be doubled.

Within the controller the circuits and parts that carry the motor current are subject to the same change in conditions as the feeder circuits. If voltage is increased they will have ample

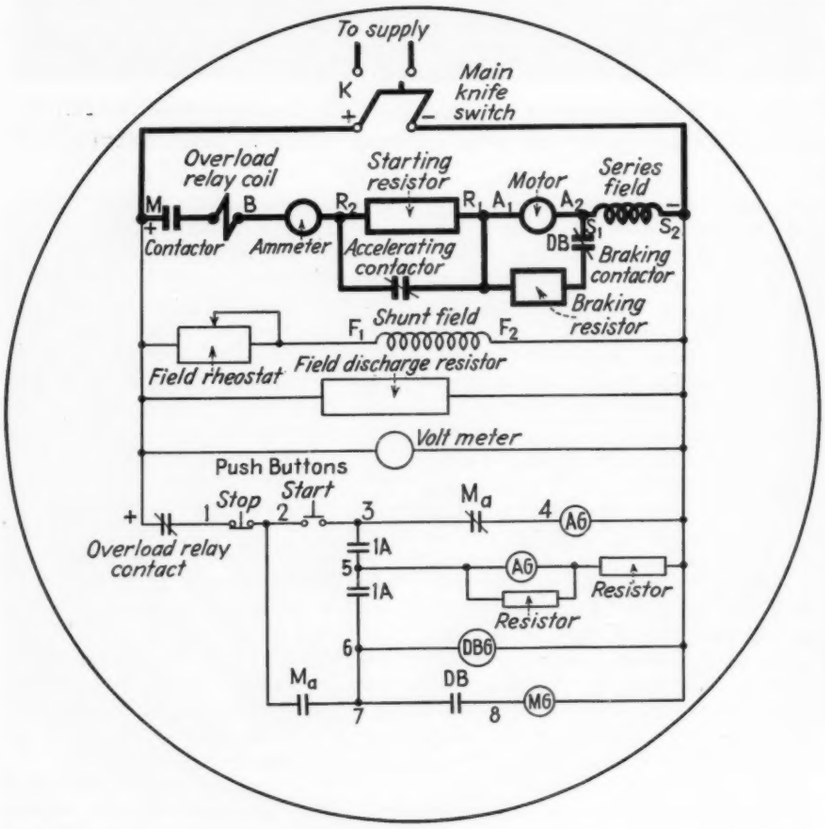

Figure 1. Circuits and parts of this d.c. controller that are affected by changes in current are shown by heavy lines. Light lines denote parts affected by voltage changes

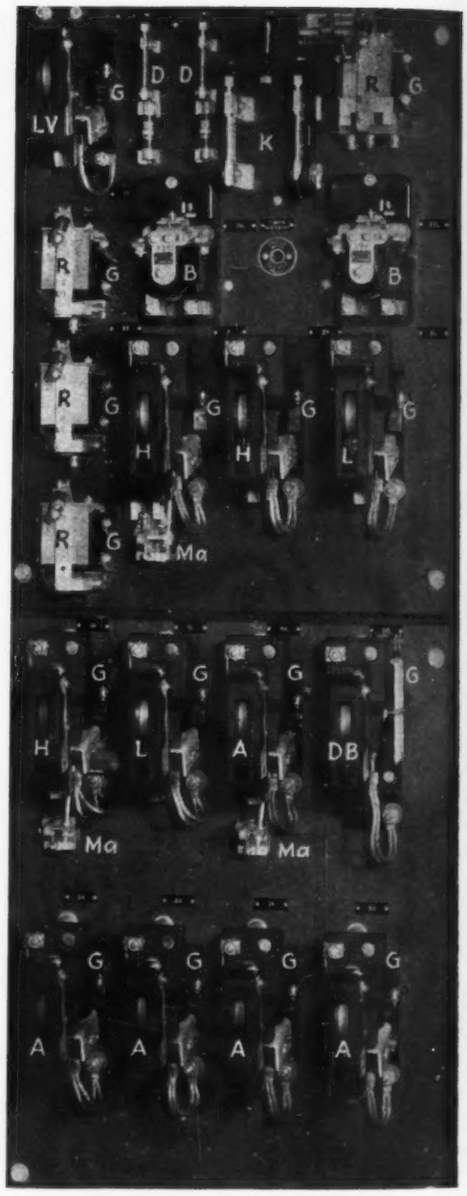

Figure 2. Parts of a d.c. controller, such as contactors and overload relays, that carry motor current are affected by changes in current. Control circuit devices usually can handle such changes

current-carrying capacity, but for a decrease in voltage the current-carrying capacity must be checked. Parts that most frequently require change because of increased current are main terminal studs for incoming line and motor connections; wires or bus copper that must carry motor currents; knife switches, disconnecting switches and fuses in the motor circuits; overload relay coils and heaters; all relays that carry motor current; and magnetic contactors for main motor circuits.

Figure 1 illustrates the circuits for a d.c. controller providing overload protection, definite time acceleration, dynamic braking, and some speed control by rheostat in the shunt field circuit. In this diagram the parts of one device, such as the main magnetic contactor *M*, are not shown close together. Contacts of *M* are shown in heavy lines, but coil *M* and the two interlocks are shown in light lines. These parts combine to make the complete magnetic contactor and two interlocks operated by it.

The heavy lines illustrate the parts and devices affected principally by the change in current requirements. The starting and braking resistors are affected by both current and voltage changes. The insulation on any part must not be overlooked if an increase in voltage is made.

Light lines indicate apparatus affected primarily by voltage changes, although current-carrying capacity of field rheostats, pushbuttons, interlocks, and control resistors cannot be ignored.

Design of a resistor is influenced by both voltage and current. Since a change in system voltage involves a corresponding change in current—power requirements remaining unchanged—resistors usually must be redesigned. The change in voltage requires different values of resistance and the change in current requires different current capacities in the resistor units. A change in supply voltage, therefore, commonly requires a redesign of all resistors in the motor circuits.

Safe practice requires adequate distance between live parts. Permissible distances vary and naturally are greater across surfaces than through air and must be increased as voltages are increased. Dirty and wet conditions require more distance between parts than clean, dry conditions. When changing an installation to a higher operating voltage, it is desirable, therefore, to be sure that the controller will have suitable insulating clearances between live parts.

Operating coils for contactors and relays are sometimes suitable for operation at several voltages. Usually, however, they are wound to operate at a rated voltage with satisfactory per-

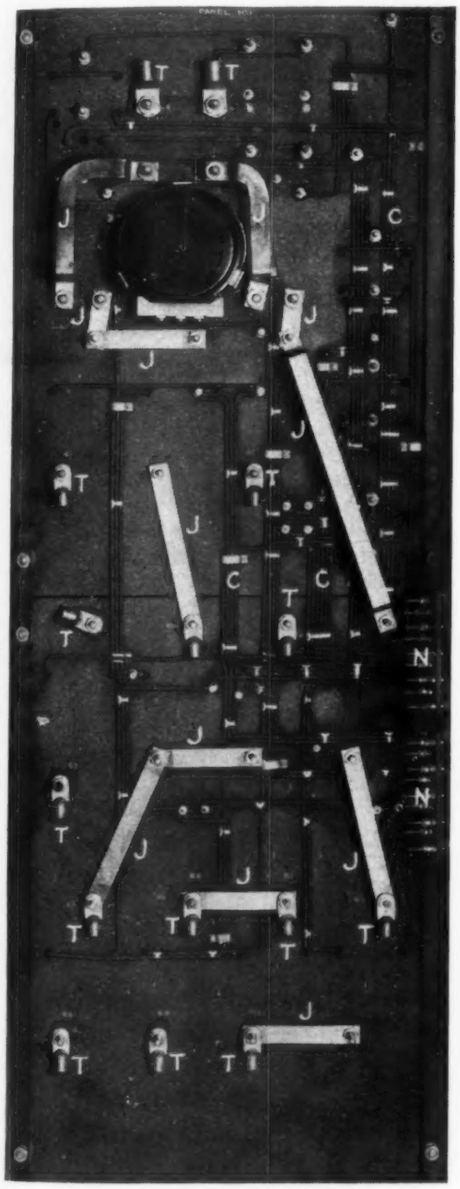

Figure 3. In this rear view of the controller in Figure 2 are shown the parts that carry motor current and therefore are affected by current changes. They are terminals, *T*, and strap connections, *J*.

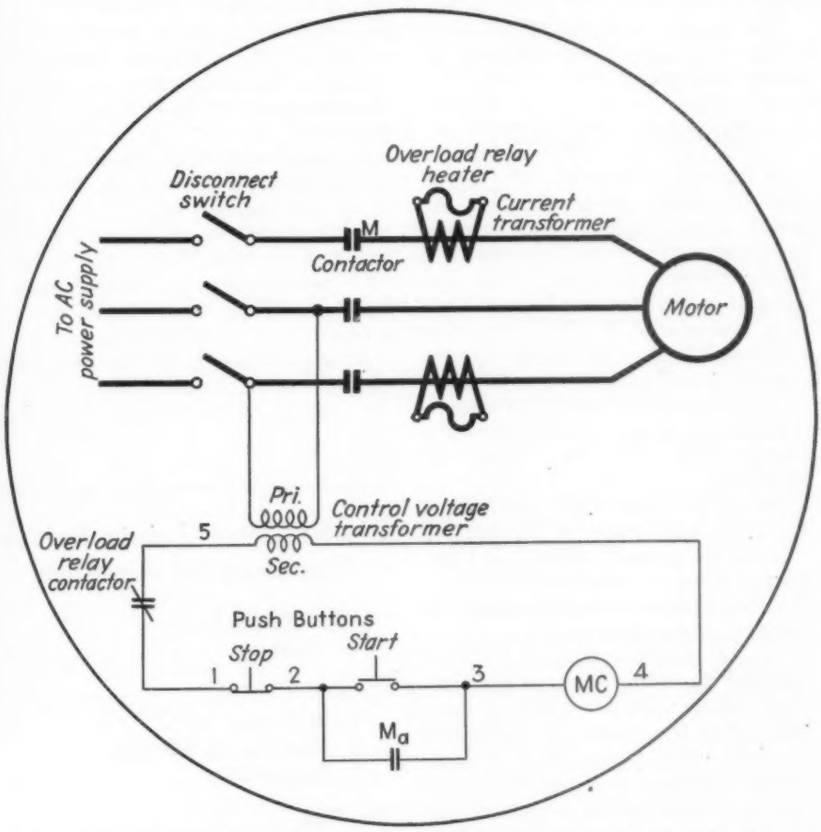

Figure 4. Heavy lines show the circuits and parts of a full-voltage a.c. starter affected by changes in current. Parts affected by changes in voltage and frequency are shown in light lines

formance at 10 percent above or 15 percent below rated value. If a given coil is applied to a circuit of lower voltage than the rating of the coil, it will not have sufficient power to operate the device. If applied to a circuit of higher voltage, the coil will overheat and soon be destroyed. Voltage coils or contactors and relays must, therefore, have a rating comparable to the voltage of the supply circuit.

Some of these points are more clearly brought out in Figure 2, which shows the front view of d.c. low-voltage, open controller. The distances between the various units are insulation distances. The higher the voltage the greater these distances must be. The main knife switch, *K*, two overload relay coils, *B*, and the twelve magnetic contactors, *H, L. LV, DB*, and *A*, must carry motor current. Hence, a change in current requirements may affect the size of these units. Control knife switch, *D*, four relays, *R*, and three interlocks, *Ma*, are control circuit devices and usually have ample current capacity at any low voltage.

The voltage coils, *G*, of the contactors and relays are affected by voltage changes.

Suitable Capacity

In Figure 3 is shown a rear view of this controller. Connections to the power supply, motor, and external resistor are made through terminals *T*. Motor current is carried from one point to another through heavy copper strap connections, *J*. These terminals and connectors must be of suitable capacity for the motor current. The control wiring, *C*, and terminals, *N*, will seldom require alteration with a change from one low voltage to another.

When a.c. controllers are changed from one application to another the number of phases, voltage, and frequency must be considered.

A three-phase controller cannot be used on a two-phase system.

On a.c. systems voltages of 600 volts and less are often designated as low. High-voltage systems include all above 600 volts. If a change in application involves using power from a high-voltage instead of a low-voltage a.c. system, a modification in existing controllers to meet the new conditions is seldom possible because the higher voltages require insulation not provided on low-voltage apparatus. An entirely new controller may be required when changing from low- to high-voltage systems.

Alterations in controllers and motors when changing from a low- to a high-voltage system may, however, be avoided by using power transformers to provide the same voltage for which the equipment was originally designed.

Changes from high-voltage to low-voltage a.c. systems permit the use of simpler, less expensive, and smaller designs. New controller designs are, therefore, desirable. Requirements such as current rating usually make it undesirable and uneconomical to adapt a high-voltage controller to a low-voltage system.

Since changes between high- and low-voltage systems usually require new controllers, possible modifications within a controller to meet new requirements occur when the change is from one high-voltage rating to another (above 600 volts) or from one low-voltage (below 600 volts) to another. For example, it may be desirable to use a 220-volt design on a 440-volt system, or a 4,400-volt design on a 2,200-volt system. For such changes, the insulation distances must be considered if the voltage is being increased. No problem of insulation distances arises if the voltage is being decreased.

As was mentioned previously, a change in voltage is usually attended by a change in current. If the power requirements remain unchanged, doubling the voltage will reduce the current by one-half. A reduction in voltage will require a corresponding increase in current.

When an increase in current occurs the capacity of all parts through which the motor current passes must be ample for the new current requirements No question of current-carrying ability arises when voltages are increased and currents decreased accordingly. If the power requirements change along with the voltage change the current rating of all parts must be checked on the basis of the new power rating, to assure adequate capacity.

Check These Points Before You Reapply Controls

On D.C. Controls

1. Voltage

On A.C. Controls

1. Voltage
2. Number of phases
3. Frequency

On Both

1. Duty cycle intended
2. Type of inclosure required

Commonly Affected

Frequency changes may or may not be accompanied by changes in voltage. The parts most commonly affected by frequency changes are meters, contactor or relay coils of the voltage type, transformers, and reactors. A decrease in frequency increases the size of such parts as transformers and reactors, so that increased space is necessary.

Figure 4 shows the circuits of an a.c. across-the-line starter providing overload protection and reduced voltage for the pushbutton control circuits. The heavy lines indicate parts affected primarily by a change in current. Insulation on the various parts must be suitable if an increase in voltage is contemplated.

The light lines show circuits primarily affected by changes in voltage and frequency. The control voltage transformer and coil *MC* are affected by changes in voltage or frequency, or both. Pushbutton contacts, overload relay contacts, and interlock contacts *Ma* must have ample current capacity, although usually they do not require any alteration for changes in application within standard voltages.

Consideration of the load conditions and duty cycle is also important when a controller is to be reapplied. For example, the controller may have been designed and built for intermittent operation. Consequently some of its parts may not be able to operate continuously under full-load conditions, or they may not be mechanically suitable for frequent operation, required in some applications.

Starting resistors are classified and designed according to a certain duty cycle. One classification provides a design for resistors in circuit for 10 seconds out of 80 seconds (70 seconds' rest period before another start is attempted). Another classification provides for 15 seconds' service out of 60 seconds. Sometimes resistors must be in the circuit continuously. Obviously a resistor designed for a duty cycle of 10 seconds out of 80, say, will not be satisfactory for continuous duty.

The type of inclosure required by the atmospheric and other conditions encountered in the new location must likewise be considered.

Failure to open a short circuit may well mean serious damage to equipment and a long delay

Breakers Have Got to Break

Part II. Whether they can safely open a circuit when a fault develops depends on their interrupting capacity and the value of the short-circuit current. This value can be calculated closely enough for the purpose, as explained here

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WITH THE DATA given in the preceding article, calculation of short-circuit currents is simple.

For example, what value of short-circuit current would be obtained in the secondary of a 2,000-kva., 440-volt, 5-percent-impedance transformer? (Full-load current, I_r = 2,625 amperes).

With unlimited primary power the transformer may be considered as the total source and the short-circuit current, in amperes, will be I_{sc} = (1.25 x 2,625) ÷ 0.05 = 65,600 amperes.

Assuming a 50,000-kva. primary limit (with 1 unit value of impedance) and reducing it to the 2,000-kva. base:

P.U. to Base 2,000 =
1 x 2,000 ÷ 50,000 = 0.04

0.04 + 0.05 = 0.09 total. Then, I_{sc} = (1.25 x 2,625) ÷ 0.09 = 36,500 amperes.

Rotating apparatus, whether synchronous machines (generators and motors) or induction motors, on low-voltage systems will feed current into a short circuit. These current contributions must be added to the short-circuit current fed through the protective device into the fault by the transformer.

The short-circuit current contribution from each machine may be calculated as:

$$I_{msc} = 1.25\ I \div Z''$$

Equation 4.

Here I_m is the normal current of the machine and Z'' is the total impedance corresponding to the combination of the subtransient reactance of the machine and the impedance of the leads, plus the devices in the machine circuits, including current transformers and disconnecting switches.

For generators and synchronous motors it is usually not difficult to get from the manufacturer data giving the subtransient reactance, and for induction motors it may be taken as the reciprocal of the locked rotor current, information concerning which is usually available.

Impedance of motor leads and circuit may be computed accurately, or mean values may be assumed to be on the order of 4 to 10 percent (p.u. 0.04 to 0.1), based upon the kilovolt-amperes of the motor in question. Generator lead and circuit impedances are usually much lower and frequently are negligible.

As an example, what additional short-circuit current would be contributed to the industrial plant supplied by the 2,000-kva., 440-volt, 5-percent-impedance transformer referred to in the previous example if the load consists of induction motors up to (a) 100 percent; (b) 50 percent; (c) any other percentage?

Assume that all the motors have similar characteristics, with locked-rotor current equal to 5.5 times normal full-load current (subtransient reactance, 1 ÷ 5.5 = 0.182) and circuit impedance of 9.6 percent.

The circuit impedance of 0.096 plus the motor subtransient 0.182 gives Z = 0.278 and

(a) I_{msc} = (1.25 x 2,625) ÷ 0.278 = 11,800 Amperes

(b) I_{msc} = (1.25 x 1,310) ÷ 0.278 = 5,900 Amperes

(c) At any other percentage:

I_{msc} = [(1.25 x 2,625) ÷ 0.278)] x *Percentage of Motor Load*

These values of motor contribution should then be added to the transformer source current, showing that the available short-circuit current at X in Figure 2* is, with 100 percent motor load:

36,500 + 11,800 = 48,300 amperes

The control and protective device at B, Figure 2, must have enough capacity to interrupt, safely and quickly, currents of this magnitude.

In d.c. systems the control and protective devices must be capable of interrupting the maximum current available. For calculating the short-circuit current it is necessary to have information concerning the maximum short-circuit current obtainable at the terminals of the machines. This information is readily available from the manufacturer.

If the control and protective devices are remote from the machine the resistance of the external circuit should be included in the calculations, and the short-circuit current then is:

$$I_{sc} = V \div (R_m + R_e)$$

Equation 5.

Here V is the voltage of the circuit; R_e, the external resistance to the point of the fault; and R_m the equivalent machine resistance, equal to the quotient of the voltage divided by the maximum terminal short-circuit current, as obtained from the machine manufacturer.

Table III. Approximate Maximum Short-Circuit Currents at the Terminals of D. C. Machines

Type of Machine	*Times Normal Current*
Shunt wound	8
Compound wound	10
Compound wound with compensating field	15

Tables I,* II,* III, and IV show the approximate impedance values of low-voltage a.c. rotating apparatus, single-phase transformers, d.c. machines, and insulated cables, respectively.

The absolute necessity for adequate

* December, 1941, pages 83–85.

interrupting capacity cannot be overlooked, but sometimes it may be unnecessary to go very deeply into studies of short-circuit current values, because capacity and characteristics of the apparatus may be such that one familiar with usual conditions will know the possibilities immediately.

For example, assume an isolated generating station with one engine-driven a.c. generator rated 500 kva., 440 volts (normal current 655 amperes). No data are at hand concerning reactance and so on but let a minimum value of 0.10 be assumed. Neglecting all external lead impedances, from Equation 3 the maximum current from the generator will be:

$$I_{sc} = (1.25 \times 655) \div 0.10 = 8{,}200 \text{ Amperes}$$

Add to this short-circuit current the contributions from a 100 percent induction motor load, based on the same assumed values in the preceding example:

$$I_{sc} = (1.25 \times 655) \div 0.278 = 2{,}950 \text{ Amperes}$$

Thus the aggregate total root-mean-square short-circuit current possible in any feeder is 8,200 + 2,950 = 11,150 amperes. If the interrupting rating of the devices to be installed is on the order of 15,000 or more amperes it is clear that no further work on short-circuit current calculations need be done.

In this example it was found that short-circuit current magnitudes are not excessive, but suppose that expansion of the plant requires doubling the generator and motor capacity. Similar assumptions of characteristics will show a possible short-circuit current magnitude of 2 x 11,150 = 22,300 amperes. Therefore if the devices have ratings of 15,000 amperes more careful analysis will have to be made to ascertain the probable short-circuit current values; or else all the existing installations of devices rated 15,000 amperes will have to be replaced.

Thus, instead of a loose assumption of 0.10 subtransient reactance of the generators, about the minimum to be expected, it may be found upon inquiry that the generator subtransient reactance is 0.20 and further investigation shows that the leads plus the current transformers add 0.005 giving a total impedance of 0.205. Then

$$I_{sc} = (1.25 \times 2 \times 655) \div 0.205 = 8{,}000 \text{ Amperes}$$

Add to this, 2 x 2,950 = 5,900 amperes, or the doubled motor contributions, and the new aggregate, 13,900 amperes, is found to be safely within the 15,000-ampere capacity of the devices.

The second part of this example will illustrate the care necessary in borderline cases, on the one hand to assure adequacy of interrupting capacity, and on the other, to save on investment costs by avoiding excessive rating.

From the foregoing it is clear that when an air circuit breaker is to be connected between a source of power and a load circuit it must have an interrupting rating equal to, or greater than, the total root-mean-square current (including the d.c. component), as figured from Equations 3, 4, or 5.

With modern breakers, properly coordinated for fast interruption, with rapid release mechanisms, suitable arc-quenching features and mechanical ability to withstand impacts resulting from electromagnetic forces set up by excessive current, a cascade or back-up arrangement may be used to obtain increased interrupting capacity over normal ratings (Figure 3).

The main breaker, A, must have an interrupting rating equal to, or greater than, the total calculated root-mean-square current, including the d.c. component, as calculated from Equations 3, 4, or 5.

The second breaker in the cascade, *B*, may be applied up to 200 percent of its interrupting rating, based on currents calculated according to the preceding paragraph.

The third breaker in the cascade, C, may be applied up to 300 percent of its interrupting rating.

In applying the cascade arrangement of breakers it is well to avoid too great a difference in ratings between successive steps; better results will be obtained if the successive steps are accompanied by successive steps in ratings. Thus if breaker A, Figure 3, has an interrupting rating of 100,000 amperes breaker *B* should preferably be the next smaller size, 75,000 amperes, and could be rated 50,000 amperes, but not smaller.

The cascade arrangement clearly results in an economy in investment in breakers, but it must be emphasized that this arrangement should be employed only with the consent, and upon the recommendation, of the breaker manufacturer.

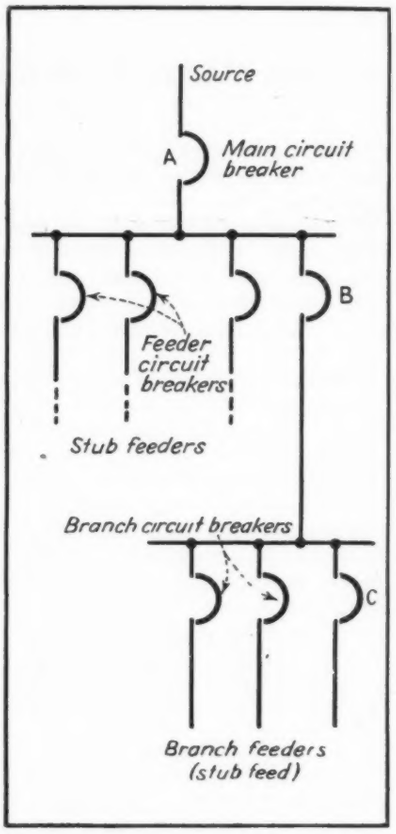


Figure 3. Increased interrupting capacity over normal rating can be obtained by arranging suitable circuit breakers in cascade

Table IV. Typical Impedance of 600-Volt Rubber or Varnished Cambric Insulated Cable*

Size of Cable AWG	*Impedance in Ohms*** Single-Conductor, 3 Cables in Non-magnetic Duct*	*3-Conductor*
8	0.662	0.658
6	0.414	0.425
4	0.254	0.264
2	0.164	0.167
0	0.112	0.110
00	0.093	0.091
000	0.078	0.074
0000	0.065	0.060
250MCM	0.060	0.054
350MCM	0.050	0.044
500MCM	0.044	0.037
750MCM	0.040	0.031

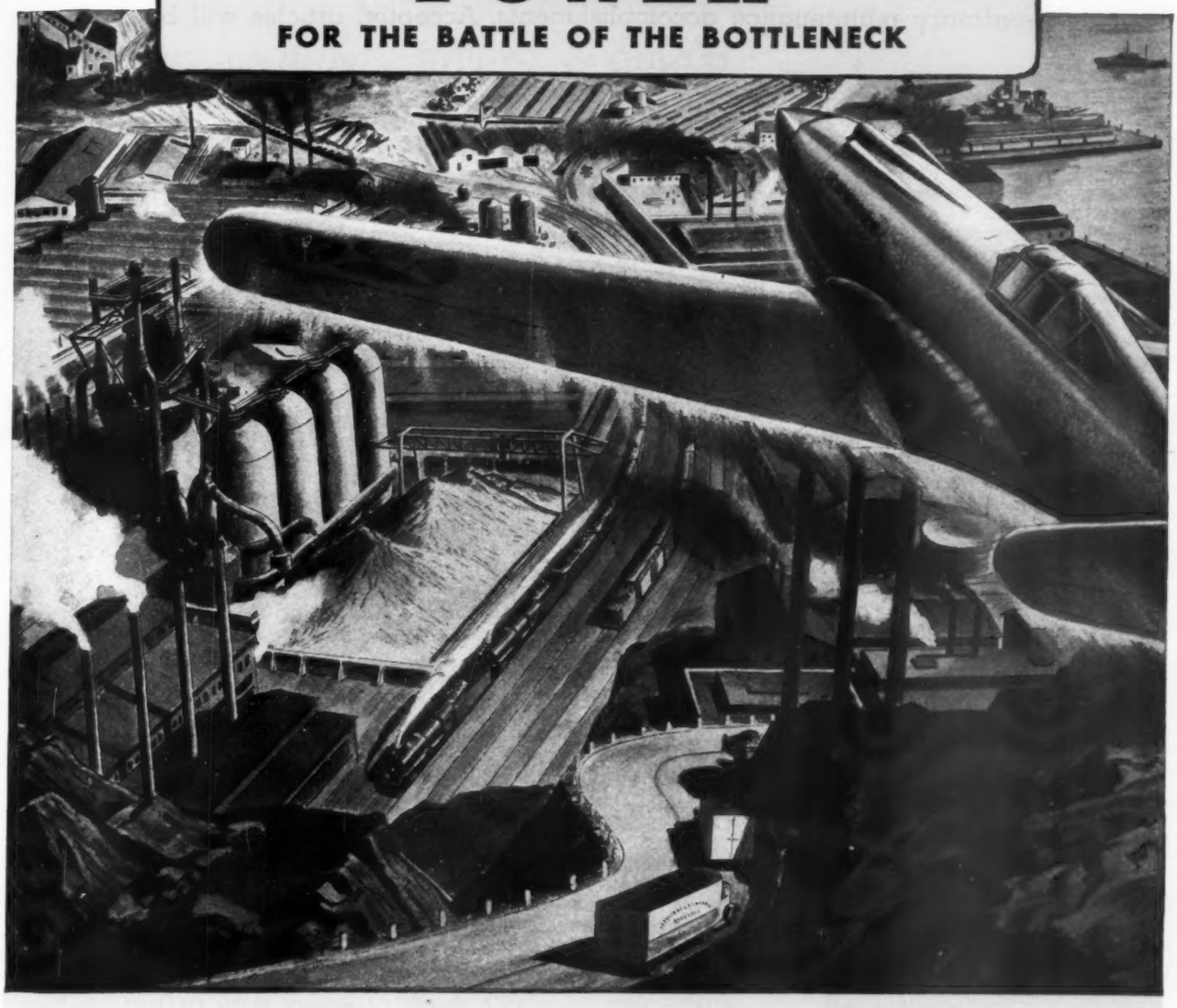
*Per 1,000 feet at 25 degrees Centigrade or 77 degrees Fahrenheit; non-shielded, non-magnetic

**Ohms units are converted to p.u. values on the kilovolt-ampere base to be considered, as explained in the text, and then added to the apparatus p.u. impedance

EXIDE-IRONCLADS PROVIDE

POWER

FOR THE BATTLE OF THE BOTTLENECK



"NO STOPPAGE . . . *anywhere!*", is the war-cry of the Battle of the Bottleneck. Important materials for National Defense must be delivered to the right spots . . . at the right times!

To keep defense materials moving, heavily-loaded industrial trucks need the abundant power of Exide-Ironclad Batteries. Exide-Ironclads provide long-lived dependability where dependability is needed most.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

Exide
IRONCLAD
BATTERIES

MAINTENANCE SHORTS

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary maintenance accomplishments. Accepted articles will be paid for

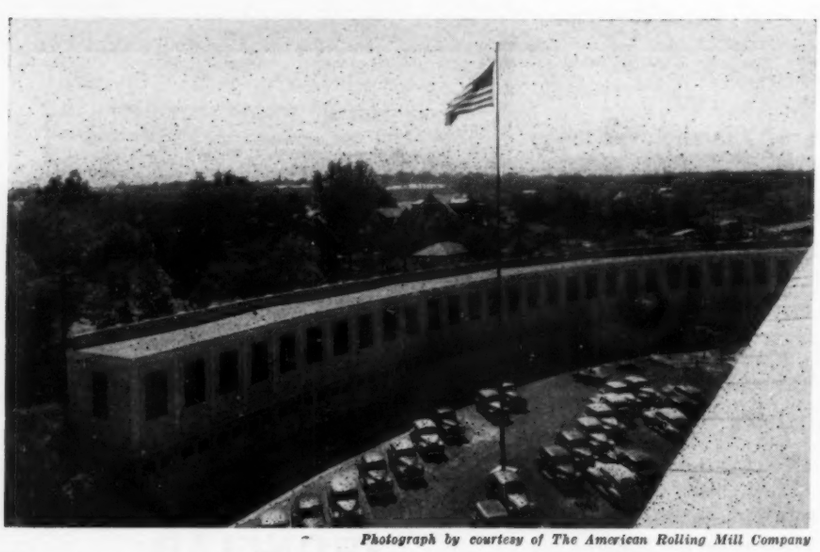
Added Story to Garage, Gained Space in Plant

Increased demand for machine tools made it necessary for the R. K. LeBlond Machine Tool Company, situated on a 20-acre plot in Cincinnati, to find more manufacturing space. Search for room to store bulky patterns ended when it was decided to add a floor to the 21x300-ft. garage supplying thirty individual parking spaces.

The garage rims an elliptical driveway, connects with the main building, and backs on a railroad spur. Its rear foundations are buried in the railroad embankment.

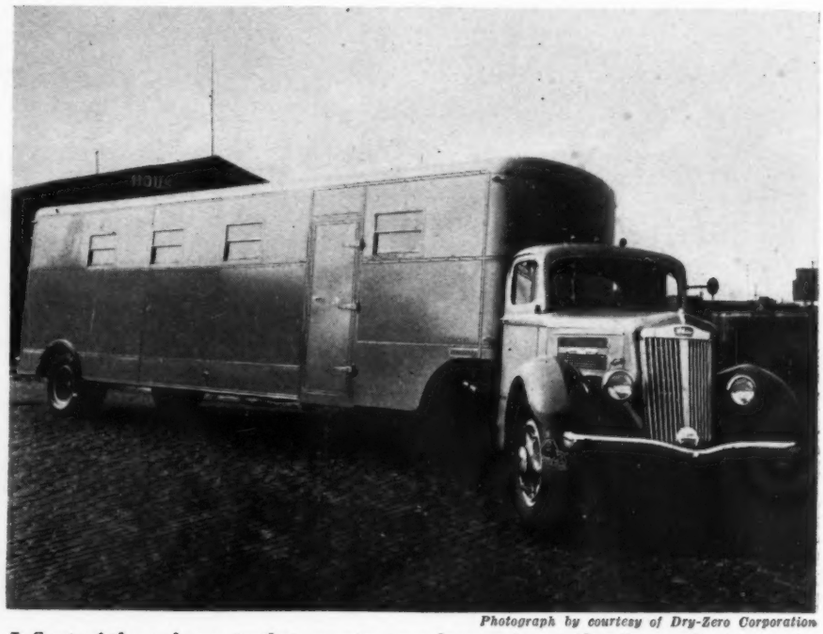
No great weight could be placed on the supports over the garage doors. Steel panels were specified because they met all requirements. After the single endwall and the 300-ft. rear wall were raised with concrete blocks (the original garage building material), a steel-panel front, 17 feet high, was added. Over-all height is now 29 feet 7½ inches. The old tar-paper roof lies about two feet below the concrete floor of the new portion. The roof is constructed of steel deck panels, insulating board, and a waterproof covering. Saddle work for drainage consists of fill.

A sprinkler system protects the patterns now stored on racks reaching to the ceiling. Heat is provided by radiators installed below the window levels, using exhaust steam. The interior, containing 107,100 cubic feet, is painted white. The exterior is gray and buff.



Photograph by courtesy of The American Rolling Mill Company

Wanted more manufacturing space in the plant, so they built a second story of steel panels and concrete block over the garage to store bulky patterns



Photograph by courtesy of Dry-Zero Corporation

A fleet of these huge trailers carries employees two miles from plant gate to production posts so that they will be sure to arrive fresh for work

Employees Ride From Plant Gate to Job

One of the large Canadian shell-loading plants, Defense Industries, Limited, a government-owned corporation, uses huge trailers to carry employees from the plant gate to various production units, a distance of two miles. Thus the plant is sure of having its workers arrive fresh and well rested for work.

Each trailer is 31½ feet long, 94 inches wide, and 102 inches high, and was designed to carry 70 seated passengers. To increase capacity the center seats were taken out to make standing room for 60 or 70 people.

Between shifts, the seats, which are hinged in the sidewalls, are fastened out of the way and the unit is used for general hauling within the plant grounds.

•

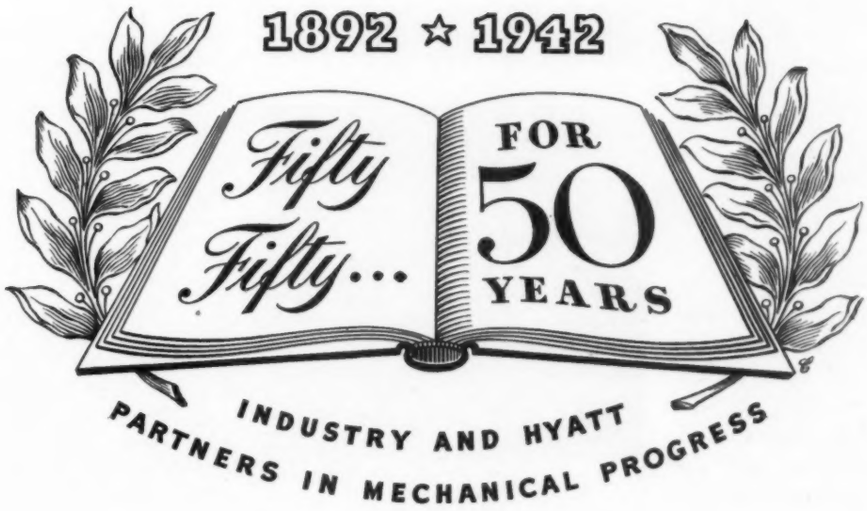
Easy to Cut Roofing With This Fixture

ROBERT S. ALEXANDER, Newport, R. I.

A cutting platform made from scrap lumber provides a ready answer to the problem of cutting unwieldy lengths of roofing and insulating material so that the ends will be square and clean and wastage will be reduced to a minimum.

The platform is laid on the floor—we found it more convenient to nail it down. One end of the roll of material to be cut is threaded under the knife slot and paid out to the required length. The blade of a sharp knife is then inserted in

THANKS, INDUSTRY!



WE'VE COME A LONG WAY TOGETHER during the past fifty years. We've helped America through emergencies . . . and through the greatest industrial era in her history. We've brought the advantages of anti-friction roller bearings to the many new and perplexing mechanisms of industrial pioneers. The accomplishments have been great, the rewards rich . . . for Industry, for Hyatt, for America!

Inventive genius and engineering talent have guided us through the years . . . the experiences of one have helped and improved the other. Many design problems have been solved. Many application handicaps have been overcome. We've shown each other many new, better ways of doing things.

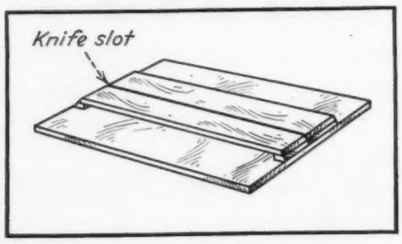
Today, on our 50th Anniversary, we feel gratified that you are placing Hyatts in machinery and equipment of all kinds...in factory and field, on highway and railway, in war and peace-time assignments . . . that you are calling upon Hyatt and Hyatt Roller Bearings, more than ever before, to help in upholding the excellence of your regular products and the products you are building for Victory.

For this confidence, again we say . . . THANKS, INDUSTRY. Hyatt aims to keep pace with you into the future—America's future—building the very best that seasoned experience and fresh imagination can produce. So let's set our sights on tomorrow . . . let's keep going "Fifty-fifty for 50 years" . . . and more!

Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Chicago, Pittsburgh, Detroit and San Francisco.

HYATT

QUIET ROLLER BEARINGS



the slot and with one pass severs the material. Where formerly two men were required, one holding a straightedge and the other cutting, now one does the job.

•

One manufacturer of cartridge cases found that adding ferric sulfate to the usual acid pickle solution insures removal of the red cuprous oxide stains and black smut frequently left on brass surfaces after heat-treating.

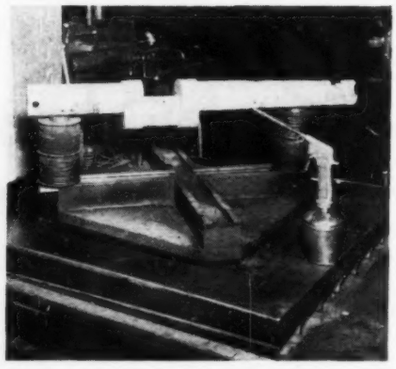
•

Magnetic Test Reveals Cracks in Crankshafts

J. A. SAMS, Works Laboratory, General Electric Company, Schenectady, N. Y.

Power presses at our Schenectady Works are tested periodically. Crankshafts are subjected to a magnetic test. Because of the tremendous strain the shafts are subjected to in operation, we test each one every time it is removed from its press for any reason.

The shaft is magnetized so that the direction of flux becomes longitudinal and so intercepts any possible cracks at right angles. While magnetized, the shaft is



sprayed with kerosene which has in suspension finely divided particles of magnetic iron oxide. Any cracks or discontinuities in the metal will set up magnetic poles, which, while very slight, are strong enough to attract and hold the iron-oxide particles, thereby outlining a crack which may ordinarily be invisible to the naked eye.

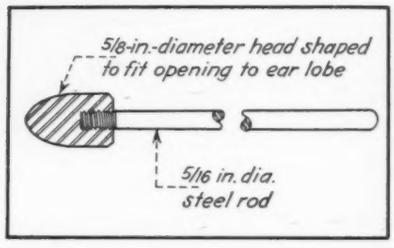
One company recently reported that out of a group of 43 crankshafts tested by this method, 14 were cracked and required replacement. Early detection of these weak spots doubtless prevented breakdown and production delays later on.

Listening Rod Detects Machine Troubles

S. H. COLEMAN, Roanoke, Va.

Good mechanics and machine operators often depend on their ears to detect the development of machine troubles not readily visible to the eye. When the sound is muffled, distorted, or drowned out by surrounding noise, a screwdriver is sometimes used. The end of the blade is held against the machine and the handle end placed against the ear.

One large industrial plant goes a bit further. There, a specially designed listening rod is considered an essential item among the necessary tools kept in every operating area throughout the plant. Attached to one end of the $\frac{5}{16}$-in.-diameter steel rod is a $\frac{5}{8}$-in.-diameter head shaped to fit the opening to the ear. It is



used in checking steam turbines for signs of internal rubbing when starting up, checking the action of steam traps to determine whether or not they are blowing through, isolating bearing troubles in reciprocating machinery, and so forth.

This simple device is to the maintenance man and engineer what the stethoscope is to the doctor.

Time and Money Saved By Welding

SOURCE—The Lincoln Electric Company, Cleveland

Welded repairs which were made in one week at a cost of $75, as compared with 10 to 12 weeks and $725 for replacement are illustrated in the photographs above. The part is a frame for an open-back inclinable press. The damaged area was cut out, studded as shown at the left, partially filled in with pieces of scrap steel and then welded as shown at the right. The finished appearance can be seen at the right

THE DANGER LIES AT THE TURNS

LOOK OUT when force hits the turns in PIPING, too!

One of the fastest, most dangerous games in the world, professional ice hockey is a series of lightning thrusts and abrupt turns. Too much speed and power in and out of the sharp curves around the goals results in many bad spills. (I.N.S. photo).

Welding with TUBE-TURN Fittings removes "Danger at the Turns" in Piping!

Abrupt turns and surging speed—the very things that cause most accidents at hockey—also account for major piping troubles.

Wherever there's *a change in flow direction,* look out for extra wear and strain. Be sure of trouble-free operation with Tube-Turn Welding Fittings. They are designed and manufactured *expressly* to protect piping systems at these vulnerable points.

There are all types, sizes and weights of Tube-Turn welding fittings—elbows, returns, tees, reducers, laterals, nipples, and flanges. For *every* welding fitting need, specify Tube-Turn fittings *by name!*

Write for Tube-Turn engineering data book and catalog.

TUBE-TURNS, Inc., Louisville, Ky. *Branch offices:* New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Tulsa, Los Angeles. *Distributors everywhere.*

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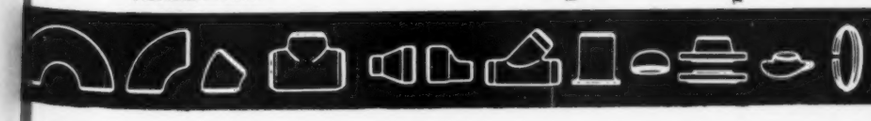


PROTECTION AT THE TURNS IN TUBE-TURN WELDING TEES

(1) *Extra thickness at crotch,* (2) *reinforcement along top of run,* (3) *reinforcement on sides,* and (4) *increased thickness at bottom* give extra strength to Tube-Turn tees at the points where stress and strain are greatest.

CROSS-SECTION OF TUBE-TURN ELBOW SHOWS SUPERIOR DESIGN

OUTER WALL NOT STRETCHED OR THINNED
SMOOTH INTERIOR WALLS NO WAVES OR RIDGES
EASY SWEEPING RADIUS THROUGHOUT
MINIMUM RESISTANCE TO FLOW
INSIDE WALL NOT THICKENED
CLEAN ACCURATE BEVEL

Here are vital engineering advantages that tell quickly why you get more with Tube-Turn welding elbows—*the elbow that made ALL Tube-Turn fittings famous.*

How to Inspect Wire Rope

A. J. MORGAN, Chief Engineer, Wire Rope and Strand Division, John A. Roebling's Sons Company, Trenton, N. J.

METHODS of inspecting wire rope can be fairly well standardized, although inspection practices in factories must necessarily vary to allow for the peculiarities of the individual installation. Evidences of deterioration in wire rope will, within fairly wide limits, be the same whether the rope is working on a mine shaft hoist or a small electric hoist. Frequency of inspection, however, can vary from daily to yearly, depending on the installation.

What Inspection Will Show

Deterioration of wire rope will be evidenced by: (1) Broken wires, (2) worn wires; (3) pitted or corroded wires; (4) drastic reduction in rope diameter and excessive lengthening of lay; (5) marks of mechanical abuse, such as flattening, distortion.

To inspect wire rope properly is to discover its worst spot. Thus, an inspection must include the entire length of the rope. If the rope is covered throughout its length with a heavy lubricant on the outside that obscures a view of the broken wires and of the abrasion-worn surfaces of the wire, provision must be made for the inspector to ascertain where the wire breaks are occurring, and the degree of the abrasion abuse the rope has suffered. In the majority of factories, however, it will be possible to ascertain the section of rope showing the most deterioration simply by looking at it.

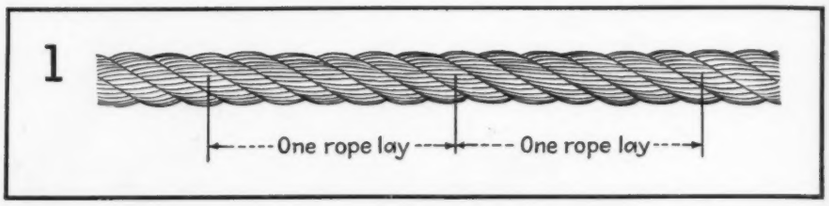
Inspection should include:

1. A quick check of the number of broken wires by rope lays, so that the worst lay can be selected. *One rope lay, Figure 1, is the distance in which one strand makes one complete revolution around the rope.*

The worst broken-up rope lay should be selected for accurate counting of broken wires, since that lay constitutes the weakest point in the rope.

Note whether the majority of these wire breaks are occurring in one or two strands, rather than being fairly evenly divided among all strands. If they are concentrated in one or two strands, the rope will be considerably weaker than if they are evenly distributed.

It should also be noted where the majority of wires are breaking in relation to their position on the strand; that is, whether they are crown breaks occurring on the top side of the strand, or whether they occur in the valleys between adjacent strands. If they are crown breaks, they probably indicate normal deterioration; if valley breaks, there may be an abnormal condition.



Distance required for a strand to make a full turn is called one rope lay

2. A check of the diameter of the rope, Figure 2, throughout its length should disclose any drastic reduction from the catalog diameter at any point. Such reduction will indicate that the hemp center has dried out and collapsed, the rope has been stretched unduly, or internal corrosion is present.

3. Inspect the degree of abrasion wear occurring on the wires. Either the length of wear should be discovered or an actual diameter check of the individual wires should be made. It is difficult to measure this wear accurately, especially in a rope built of small diameter wires; but some check must be made.

4. Note carefully, not only in the worst broken-up section of the rope but throughout its entire length, whether any signs of rust are appearing. Internal corrosion in a rope may be evidenced by a showing of rust in the valleys between the strands. Pitting will usually be discovered more readily in the same valleys. It is possible to have internal corrosion, however, with no external signs.

5. Note whether wire breaks and abrasions occur in one short section, or whether they are distributed throughout the length of the rope. Usually wire breaks will be concentrated in the portion of the rope which passes most frequently over the sheave during normal operation; in sections of rope that wind onto drums most frequently; or in sections where wear is concentrated either by mechanical abuse or other factors.

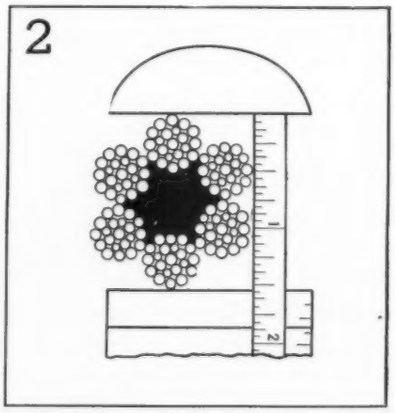
6. Note carefully the condition of the rope near attached fittings.

Diagnosis

Wire breaks in a rope occur from a number of different causes, of which the more common are shown on the next page.

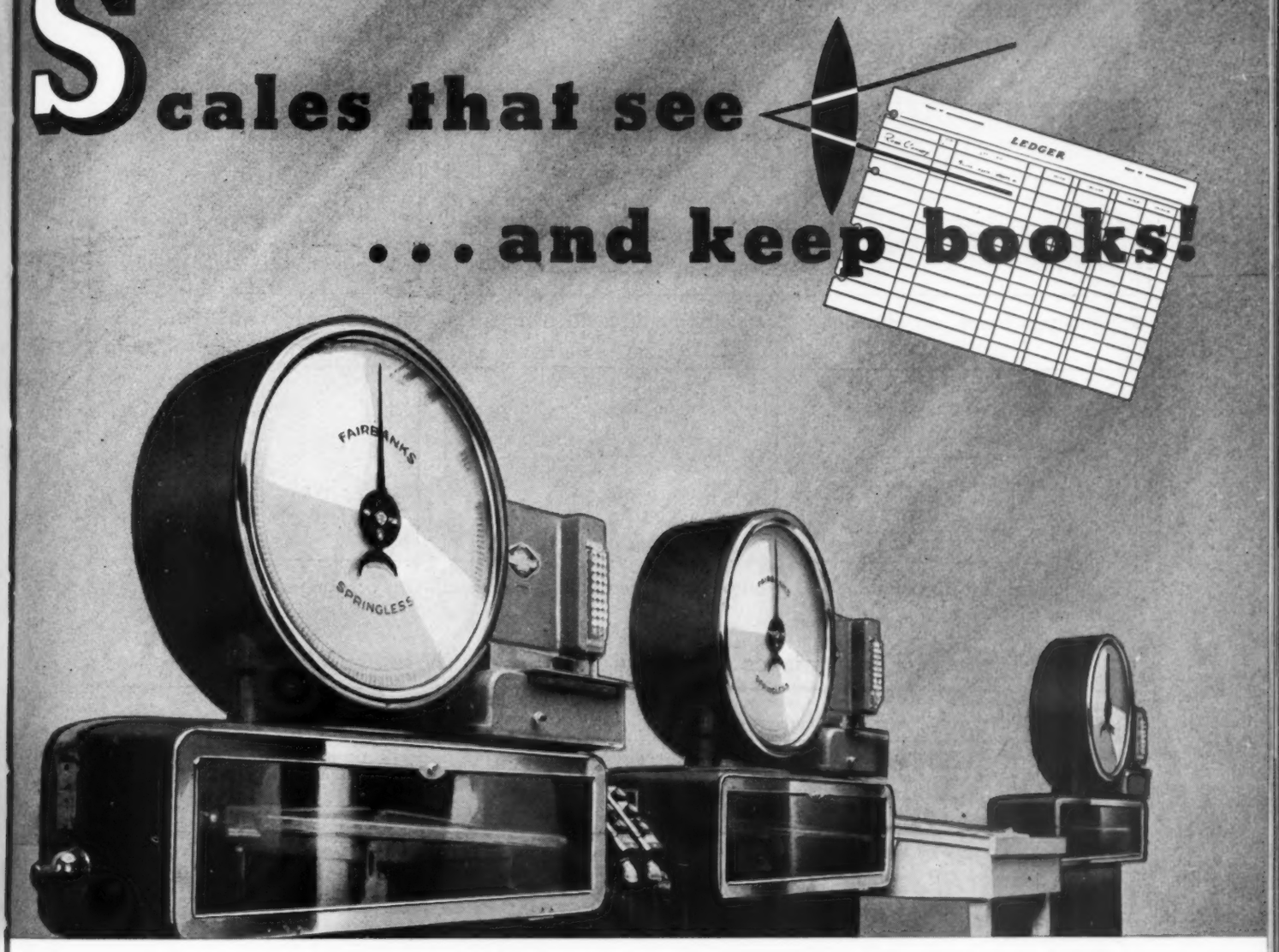
If it is desired to make a detailed study of rope service to discover the maximum reasonable rope life for a given installation, it is necessary to know the distribution and character of wire breaks, and other defects, the rate of deterioration, and their location on the equipment. These data in reasonable detail will indicate either whether a more suitable rope can be used, or whether improvements should be made on the installation.

(*Continued on page 128*)



This is the correct way to measure the diameter of a wire rope

Scales that see ...and keep books!



IT costs money to be inaccurate with "tonnage"—and it costs more money to be s-l-o-w.

In one of the most modern coal preparation plants in the world, Elkhorn Coal Company, Wayland, Ky., you will find a battery of the most modern scales handling "tonnage" at high speed.

These Fairbanks Scales with "electric eyes" shut off flow to hoppers automatically when the pre-set weight is obtained. A printed record is made of each operation automatically, and an ingenious keying system credits the tonnage to the man who mined it.

To make errors in weighing well-nigh impossible, to fit weighing speedily into the production flow, to protect alike the buyer, seller, and all whom weighing affects is the aim of this, the most experienced and most modern organization of scale makers.

There are Fairbanks Scales in types for your every weighing need... and Fairbanks Scale Engineers are available at your call.

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It is our desire to do everything we can to aid in the speed-up of American production. Our scale engineers can possibly suggest new and more efficient use of your present scales or modification which will expand their capacity.

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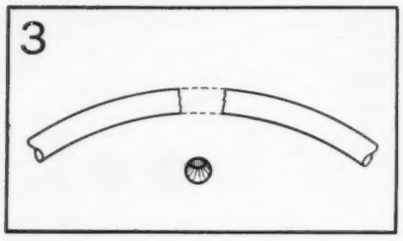
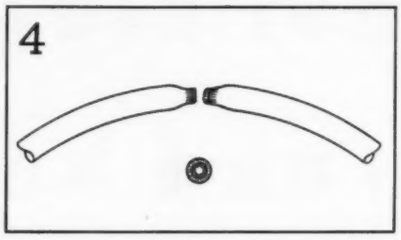
How to Inspect Wire Rope

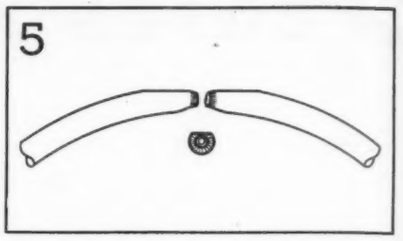
(Continued from page 126)



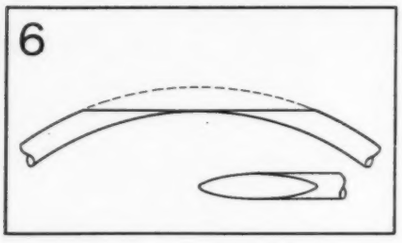
Fatigue-type break, no abrasion



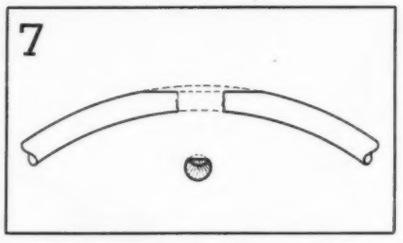
Cup-and-cone break, no abrasion



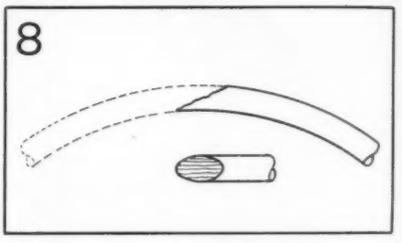
Cup-and-cone break, abrasion



Worn through by abrasion



Fatigue-type break, with abrasion



Cut or gouged wire

Typical Characteristics and Causes of Broken Wires in Wire Rope

Type of Break	*Characteristics*	*Cause*
Fatigue	Wire break will be transverse; cross-sectional view of broken ends will show granular structure. (See Figures 3 and 7.)	Where fatigue breaks occur, rope has been bent around too small a radius too often, or it has been subjected to vibration or whipping. Fatigue also often occurs after wire has been damaged by corrosion.
Tension	Wire break will show one side of broken wire coned, the other cupped. (See Figures 4 and 5.) This type of break also can develop on wire showing abrasion.	Where tension breaks are found, rope has been subjected to too great a strain, either for its original strength or for the strength remaining in it after other factors of deterioration have weakened it. Frequently tension breaks are caused by suddenly applying a load to a loose rope, thereby setting up incalculable impact stresses.
Abrasion	Wire break will show broken ends worn smooth to knife-edge thinness. (See Figure 6). Wire broken by abrasion in combination with another factor will show a combination of characteristics. Figure 7 shows combination of abrasion and fatigue.	Abrasion wear obviously will be concentrated at points at which the rope is rubbed most constantly. These points usually are the grooves of sheaves and drums and any other object with which the rope comes into contact. Unwarranted abrasive wear indicates improperly grooved sheaves and drums, or other localized abrasive condition.
Corrosion	Can easily be noted by pitted surface of wire, with break usually showing evidence of one of the three foregoing factors.	Indicates improper lubrication. Extent of damage by corrosion to interior of rope is extremely difficult to determine; consequently, corrosion is one of the most insidious and dangerous causes of rope deterioration. If hemp center of wire rope is not lubricated and is allowed to dry out, it will collapse and fail to afford proper support for strands, thereby causing marked reduction in rope diameter and extreme internal wear.
Cutting	Wire will be pinched down and cut at broken ends, or will show evidence of a shear-like cut. (Figure 8).	These conditions are evidence of mechanical abuse caused by agents outside the installation or by something abnormal or accidental on the installation itself.
Torsion or Twisting	Wire will show evidence of twisting and corkscrew effect at broken ends.	
Mashing	Wire will be flattened and spread at broken ends.	

HE IS ONE OF THE MILLION MEN ILL AND ABSENT EVERY DAY

—who cost your business a week's production a year

—who cost America the time to build 15,000 bombers

You can expect every employee to average *one week's absence a year.* This startling figure is based on a report published by the United States Public Health Service.

Over 50% of this lost time is due to colds and their complications, it has been estimated. Common communicable illness is a heavy load on American industry . . . a drag on vital defense production.

A sound health program can do much to reduce absence in industry. Among companies which established health programs, 92% reported fewer absences in the Industrial Health Practices survey of the National Association of Manufacturers.

Essential in any health program is the provision of individual towels, soap and hot water. Personal cleanliness is an effective weapon against the spread of communicable illness.

1941 sales increases show that over 50% more workers are now provided with individual, cloth-like "Soft-Tuff" ScotTissue Towels. When wet, these improved towels have 10 times greater rub strength than previous ScotTissue Towels. One "Soft-Tuff" towel does a complete drying job, brings worth-while economies.

• • •

For expert help in improving washroom hygiene, comfort and efficiency, call on the Scott ***Washroom Advisory Service.***

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INDIVIDUAL... SANITARY

Soft-Tuff

ScotTissue TOWELS

Chances are he's hanging it in a PENCO LOCKER

Every day throughout the nation Uncle Sam's workers hang up their coats, roll up their sleeves and go to work for the defense of Democracy. Thousands of men are putting their best efforts into this gigantic task and storing their belongings in Penco Lockers—the lockers that fulfill all defense requirements.

To meet the vital need for steel lockers and other industrial storage equipment in defense industries, Penco has adopted a "Defense First" policy. The new Penco Tool Stands and Cabinets are designed to aid production—Penco Steel Shelving is another name for efficient and simplified storekeeping.

Like numerous other prime and sub-contractors, you too can benefit from the systematic storage facilities provided by Penco equipment. Investigate the PENCO advantages for *your* plant.

1869 Penco

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YOU WANT TO KNOW

more about the items mentioned on this page

Letters to the addresses given will bring information

• THINK OF NYLON, and you think of women's hosiery. But have you thought of how nylon is made? "The Story of Nylon" outlines its history, takes you on an illustrated tour of the du Pont plants manufacturing it, and then on to Cooper, Wells & Co., St. Joseph, Mich., to show you how that company converts nylon into hosiery.

• LATEST in a watchman's nightstick is one that has a small radio device secreted in the handle. By pressing a button the watchman can send a pre-arranged wireless "key signal" to set off alarm sirens or bells, transmit a private warning to other guards, or notify police headquarters. Rowe Radio Research Laboratory Co., 4201 Irving Park Blvd., Chicago.

• YOUR VEST POCKET is big enough to hold a draft gage developed to measure accurately the air movement across your plant floor or the force of the draft that chills your neck. Place it on the floor or other convenient spot and read it from above. F. W. Dwyer Mfg. Co., Chicago.

• ENGINEER'S HANDBOOK on patent law explains the basic fundamentals of the law and the general rules pertaining thereto that an engineer should know to avoid patent troubles or to help his attorney solve them. Allis-Chalmers Mfg. Co., Milwaukee.

• FIRST ANNUAL REPORT of the Training within Industry Division of the Office of Production Management, Social Security Building, Washington, briefly outlines the results obtained in activities and services to defense contractors from September, 1940, to September, 1941. Also lists 22 district offices and names of representatives and advisers.

• COMBINING LEATHER on one side for protection and lastex on the other for snug fit, a new finger guard helps protect fingers and thumbs from injury by buffers, polishers, grinders, stamping-out presses, and other machinery. May be worn under gloves. Industrial Gloves Co., Danville, Ill.

• TIME-CONSUMING drafting - room job of hand lettering specifications, dimensions, and other data on tracings can be done quickly and mechanically by an engineering Vari-Type. Various sizes handle tracing cloth and paper up to 12 feet in length. Ralph C. Coxhead Corp., 333 Sixth Ave., New York.

• TASTELESS LIQUID added in small quantities to water is said to prevent rust in and insure clear water from metal tanks or pipes, and lead, brass, or black, galvanized or cast-iron water systems. Said also to clear out loose rust from old rusty tanks and pipes. Sudbury Laboratory, South Sudbury, Mass.

• FOR GRADES of corrugated wrapping paper that are not easily torn from their rolls with the regular straight-edge blade,

AIDED BY PORTABLE FLUORESCENT LIGHTS incased in transparent tubes, employees at Lockheed find they can see clearly into dark corners because the light shed by the lamps is so directed as to eliminate shadows in limited working areas. They are lightweight, low in wattage, and emit "daylight" illumination. Day-Ray Products, South Pasadena, Calif.

Still on the Job after 35,136 Hours..

SOLNUS HYDRAULIC OILS

*Help Presses Maintain Higher P.Q.**

Clogged oil lines . . . loss of efficiency . . . faulty pressures . . . frequent oil changes are a thing of the past and Production Quota is at a new high with SOLNUS Hydraulic Oils. That's the record of one large manufacturer of wire products.

The hydraulic systems of four welders, with a capacity of 30 gallons each, were filled with SOLNUS Hydraulic Oils nearly two years ago. They've been on the job ever since . . . developing pressures of 400 to 600 pounds! There hasn't been one moment lost because of shutdowns for cleanouts. In fact, samples removed for laboratory tests proved there had been no substantial change and these oils were suitable for many hours of future use.

If you are troubled with time consuming cleanouts due to formation of sludge and clogged oil lines call in a SUN Oil Engineer today. Let one of these "Doctors of Industry" prove to you how SOLNUS Hydraulic Oils make possible a higher Production Quota.

SUN OIL COMPANY—Philadelphia

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*Production Quota

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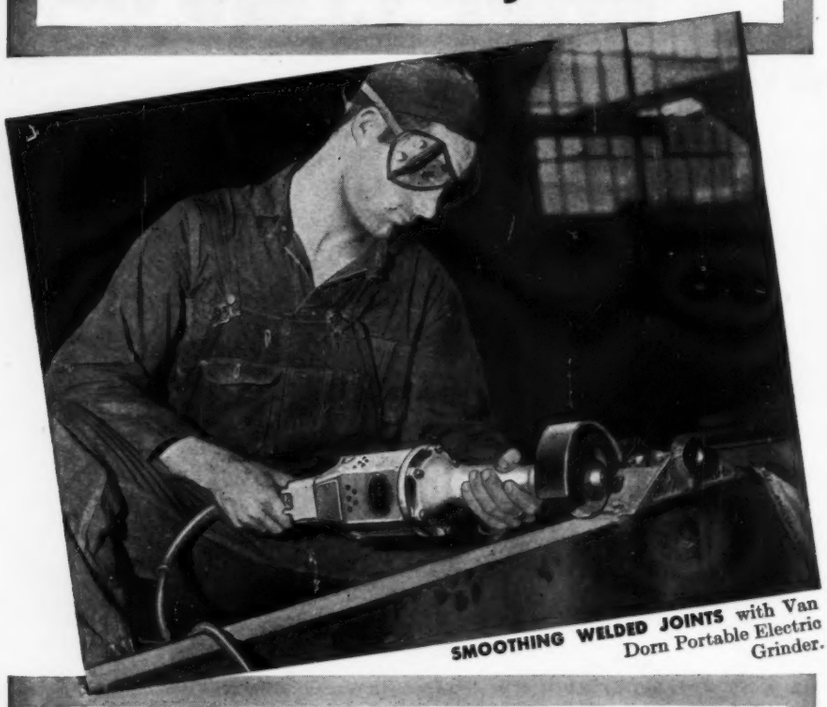
VAN DORN Quality PROVED



SMOOTHING WELDED JOINTS with Van Dorn Portable Electric Grinder.

On BUSY Production Lines

WHETHER building tanks, dive-bombers or "jeeps," production men first tool-up with VAN DORN! Knowing electric tools from handle to "head" or front end or spindle, they'll tell you that for over 35 years Van Dorn Tools have been the "stand-out" for power, stamina and sound engineering. They're powered to whizz through tough jobs in split seconds. They're engineered to stand abuse . . . to keep going three shifts with minimum layoffs for repairs.

That's why Van Dorn Tools are the answer to a production man's prayer for tools that keep going through heavy-duty production drilling, grinding, cutting or assembling jobs. It takes but a phone call to have your jobber to demonstrate the exact size and type Van Dorn Portable Electric Tools that help you roll out production jobs 'way ahead of schedule. The Van Dorn Electric Tool Co., 719 Joppa Rd., Towson, Md.

"Van Dorn"

(DIV. OF BLACK & DECKER MFG. CO.)

PORTABLE ELECTRIC TOOLS

E. O. Bulman Mfg. Co., 1705 Elizabeth Ave., Grand Rapids, Mich., has equipped a new dispenser with a conventional blade plus a renewable razor-blade cutter for difficult papers (including tar-lined wrapping and insulating paper).

IDEAL FOR INVENTORY and stock records are these wheel files, says Wheeldex Mfg. Co., 91 Wall St., New York. Set in specially built desks, cabinets, or tables, or on top, they are convenient to use and help speed up office production. Models hold from 1,000 to over 5,000 cards

● IF YOU BRUSH an odorless, colorless, non-flammable liquid on the newspapers, clippings, and pamphlets you file away, you'll find, it is said, that they resist the disintegration and discoloration caused by time and atmosphere. Also, they say, the liquid does not bleed printing ink and it increases tearing resistance of almost any wood-pulp paper 35 percent. Martin Dennis Co., 859 Summer Ave., Newark, N. J.

WITH an illuminated magnifier, available in two types—with a 3-in. lens and a special 2-in.-wide achromatic lens with magnification power of three plus, war industries can save considerable time in detecting such defects as burrs and poor finish on small parts, cracks in steel after hardening, blowholes in castings. Uses two 110-volt bulbs. George Scherr Co., Inc., 128 Lafayette St., New York

SERVICE	REQUIREMENTS	DEPTH TYPE FILTER	CUNO FLO-KLEAN
Filtration of grinder coolant to battery of bearing raceway grinders.	Minimum maintenance. Freedom from production delays.	Production must be halted for periodic repacking of element.	No stops for filter cleaning.
			Permanent filter element.

SERVICE	REQUIREMENTS	TWIN BASKET STRAINERS	CUNO AUTO-KLEAN
Filtration of fuel tar to protect industrial burner and instruments. Viscosity over 20,000 SSU at 210°F.	Minimum maintenance.	Inoperative half must be disassembled for cleaning.	Cleans itself without attention — without stopping flow.
	Must withstand high pressure drop.	Collapsible under high pressure drop.	Non-collapsible.

SERVICE	REQUIREMENTS	SCREEN	CUNO AUTO-KLEAN
Removal of foreign solids from rubber cement having viscosity of 26,000 centipoises.	Continuous flow with minimum pressure loss.	Screen previously used created prohibitive pressure drop and necessitated production delays for periodic cleaning.	Cuno Auto-Klean with same free area increased flow 63% and decreased pressure drop 72%. Cleans itself continuously.

SERVICE	REQUIREMENTS	WIRE WOUND FILTER*	CUNO AUTO-KLEAN
Removal of lint and dirt from washing and rust-proofing compound sprayed on car bodies.	Uninterrupted flow.	Self-cleaning without stopping flow.	Self-cleaning without stopping flow.
	Positive removal of all lint and dirt to prevent clogging of spray nozzles.	Not effective against lint.	Removes lint continuously.
		* Both Cuno Wire-Wound and competitive make were considered.	

Naturally, the Cuno Filter has a wider range of application than the four services described above. See column below.

More Services Where Cuno "Filter-Fine" Strainers Give Uninterrupted Protection against abrasive particles . . . product contamination

Acids
Adhesives
Air
Alkali
Animal Oils
Boiler Feed
Casein
Cleaning Solutions
Coatings
Compressed Air
Coolants
Cutting Oils
Dip Tank Systems
Enamel
Engine Fuel
Engine Lubricating Oil
Fuel Oil
Fuel Tar
Gases
Gasoline
Grease
Grinder Coolant
Hydraulic Oil
Ink
Japan
Lacquer
Lubricating Oil
Machine Tool Cutting Oil
Machine Tool Hydraulic Oil
Machine Tool Lubricating Oil
Nitrocellulose Solutions
Oils
Paint
Palm Oil
Paste
Pyroxylin
Quenching Oil
Resins
Rust Proofing Compounds
Sizing
Solvents
Spray Systems
Syrups
Tar
Test Stand Lubricating Oil
Varnish
Vegetable Oils
Washing Compounds
Water
Wax

KEEP FLOW ON "GO" WITH

CUNO

THE "FILTER-FINE" STRAINER

New bulletin describes various Cuno models for this wide range of applications. Write for a free copy of "Quick Facts."

CUNO ENGINEERING CORPORATION
601 South Vine St., Meriden, Conn.
Please send free copy of "Quick Facts" to:

Name.....

Company.....

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NEW Catalogue

Self-Lubricating BRONZE BEARINGS

This new book will save you time, trouble and money when ordering self-lubricating bushings or bearings. Thirty-six pages filled with useful, informative data will help you to accurately determine your needs. A complete listing of over 2000 individual sizes . . . including plain, flanged and spherical bearings . . . will help you design to standards thereby eliminating delay and die expense.

Competitive tests in practically every type of industry have definitely proven the superiority of Johnson Bronze LEDALOYL. Our exclusive process of PRE-ALLOYING the basic materials provides bearing qualities not obtainable by any other method.

Write for your free copy of this new book today. It will help you get better bearings—quicker. It is your first step toward improved bearing performance.

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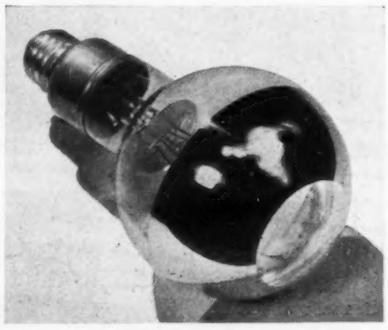
512 S. MILL ST., NEW CASTLE, PA.

Specify JOHNSON BRONZE

WHAT'S NEW IN EQUIPMENT

Infra-Red Tungsten Heat Lamp

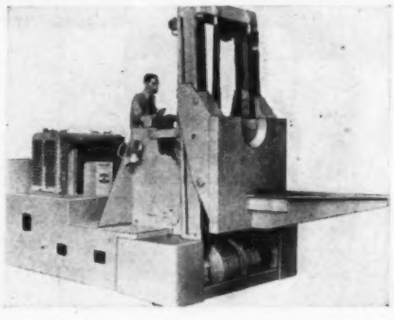
Infra-red heat lamp is said to control "spilled heat rays" and to put them to work for heating. Bullseye type bulb features a ring lining of pure silver sealed inside the bulb at a point just below the focal point of the filament. This silver ring leaves a clear "bullseye" spot through which heat beams are projected from the filament direct to the heating area without spill or loss. All remaining heat rays, including what were formerly "spilled heat" rays, are now gathered into the control area of the reflector by the silver ring lining and projected down to the heating area.



By utilizing this extra 25 percent heating value, bulb is said to make greater heating efficiency possible, with greater concentration of heat beams in a given area, and faster, more economical operation. A special feature is the mechanical strap-in base made heatproof to keep the base from loosening under the heat developed in infra-red tunnel installations. Available in the 250-watt size, tungsten filament only, to fit the standard Edison screw socket. Average burning life is in excess of 5,000 hours. Birdseye Research Laboratories, Wabash Appliance Corp., 335 Carroll St., Brooklyn.

Ram Truck

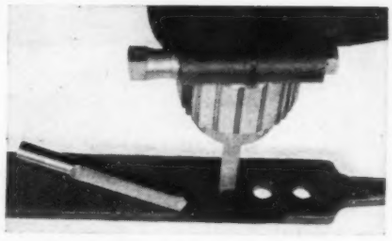
Ram truck with a rated capacity of 25,000 lb. is announced. Claimed to be first truck within this range to have the drive under the load end of the truck. Has four wheels, arranged in pairs, across the front. Each pair supports the frame on pivots or is articulated so that wheels conform to floor irregularities. All four wheels are provided with hydraulic brakes and new method of arranging oil lines. One wheel of each pair is driven by means of long center roller chain from motor differential bearing axle, located forward of power or battery deck. Weight is completely supported by the articulated driven wheels, thereby reducing dead weight.



Equipment includes extra heavy drive and power plants, full magnetic contactor control of all operations, and follow-through type power steer. Wheel guards around two outside wheels and extra heavy bumper channel across front of truck protect tires from projecting objects. Guards clear floor by about 3 inches. Elwell-Parker Electric Co., Cleveland.

Drill

Drill which will cut hardened steel of any type, temper, or analysis, known as the "hardsteel" drill, has been used successfully on carburized, oil-hardened-water-hardened, cyanided, and nitrided pieces of high carbon, high chrome, and high speed drills. Made by a secret process, hardsteel drills are designed to drill, ream, countersink, and counterbore, and will do so without tearing or annealing the steel



on which they are used, leaving a smooth burnished surface within the hole, it is claimed.

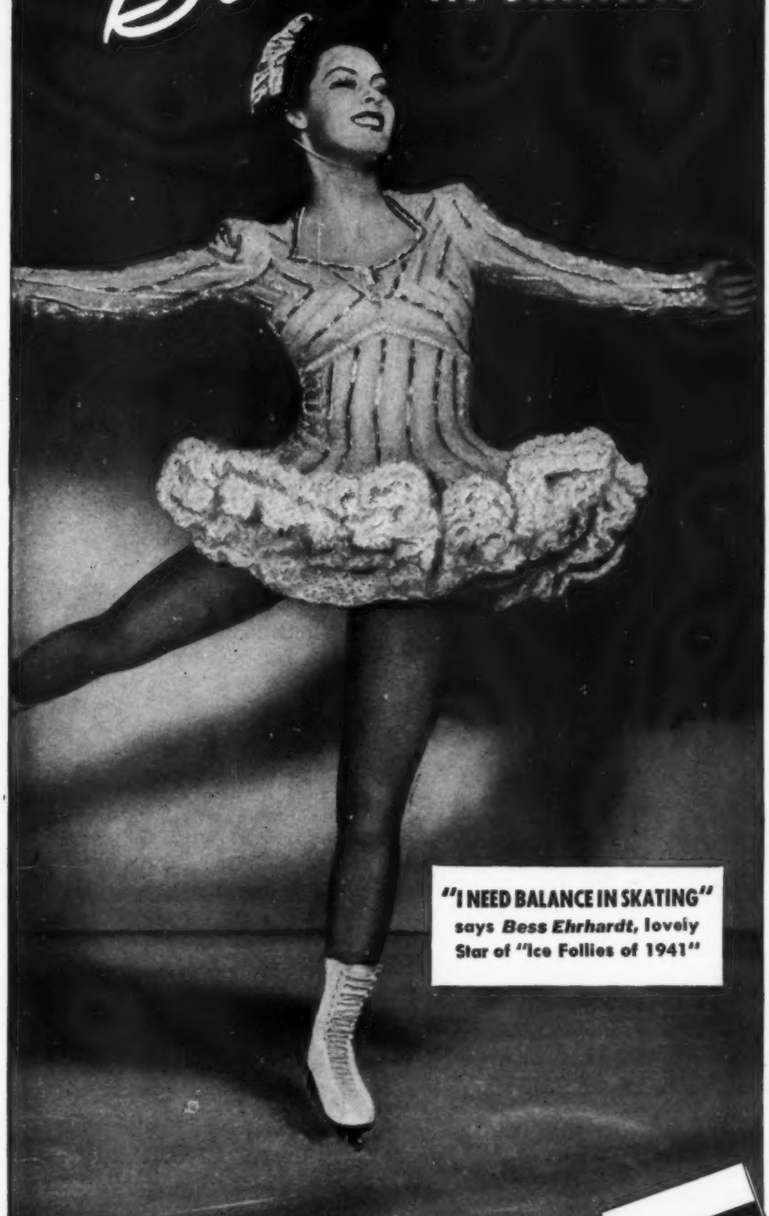
Have been used as salvage tools, for drilling holes in dies, tools, and pieces of machinery which have been hardened and cannot successfully be annealed for machining. Will ream chilled castings without noticeable wear, cut manganese steel with ease, drill fired porcelain without chipping or breaking it, cut sheets of pure carbon, and penetrate baked enamel without cracking it.

Will not draw their own temper, and when they do show wear can be ground on an ordinary wheel. Black Drill Co., Cleveland.

Electronic Motor Control

An outgrowth of thyratron speed control for d.c. motors, electronic control system, called Thy-mo-trol, provides simple, step-

I NEED *Balance* IN SKATING



"I NEED BALANCE IN SKATING" says *Bess Ehrhardt*, lovely Star of "Ice Follies of 1941"

AMERICAN ENGINEERING COMPANY

You Need BALANCE in a HOIST

LO-HED, the *Balanced* Hoist. It's balance that makes the difference between a Lo-Hed and any other hoist. In this different hoist the motor and drum are on opposite sides of the beam. The hook goes up so close to the beam you can scarcely jam your thumb between. You get a compact, balanced hoist, minimum headroom, efficient spur gearing, and a sturdy frame, plus all the practical features a hoist should have. A Lo-Hed is worth a few dollars more but it will make a difference in your operating and maintenance costs. Look at a Lo-Hed and you won't have to look further. Write for Lo-Hed catalog today.

LOOK AT THE BALANCED LO-HED!

It Costs Less To Operate—All gears are efficient stub-tooth spur gears running in a sealed oil bath . . . gear shafts and trolley wheels are equipped with heavy-duty ball or roller bearings.

It Costs Less To Maintain—Sturdy construction . . . seldom, if ever, requires removal from rail . . . covers of controller, motor, drum and gearing are easily removed.

It's Safe—Factor of safety of over 5 at full capacity . . . 100% Positive Automatic Stop when load reaches upper limit . . . Automatic Holding Brake prevents load from drifting when current is shut off . . . short, strong shafts minimize torsional stresses.

It's Protected—Controller is fire, dust and moisture proof . . . motor totally enclosed . . . gearing sealed in . . . motor and drum covered by easily removable covers.

The Lo-Hed Hoist Is Applicable To Any Monorail System
There's A Balanced Lo-Hed Electric Hoist For Every Purpose

OTHER A-E-CO PRODUCTS: TAYLOR STOKERS, MARINE DECK AUXILIARIES, HELE-SHAW FLUID POWER

Look in your Classified Telephone Directory under "A-E-CO LO-HED HOISTS" for your nearest representative.

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☐ Please send me your complete catalog of LO-HED HOISTS.
☐ Ask your representative to get in touch with me promptly.

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(Please print plainly)

Your investment in approved equipment to protect your workers on-the-job is a sound one—important as any in your entire operations, *and as deserving of careful maintenance.* Regular inspection and adjustment gets the most out of your equipment in safe performance and extended service-life, and is of equal benefit to management and men.

LET YOUR M·S·A MAN ASSIST YOU REGULARLY WITHOUT OBLIGATION

Call in your M.S.A. Representative. Without obligation, he'll be glad to give you the benefit of his professional skill and experience in reviewing your equipment regularly—making adjustments as needed, and advising you as to condition. Let M.S.A. cooperate with you in keeping your tools of safety in top condition at all times!

✓ GAS MASKS
✓ RESPIRATORS
✓ HOSE MASKS
✓ GAS DETECTORS
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✓ ALL-VISION FACEPIECE
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✓ OXYGEN BREATHING APPARATUS
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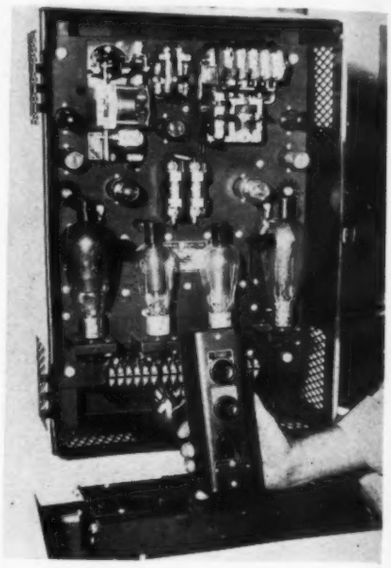
✓ INHALATORS
✓ FIRST AID EQUIPMENT

MINE SAFETY APPLIANCES COMPANY
BRADDOCK, THOMAS AND MEADE STREETS · PITTSBURGH, PA.
District Representatives in Principal Cities

less control of d.c. motors from a.c. lines where a wide speed range is needed. Normally consisting of three separate units, a small control station, a transformer, and a thyratron tube panel, the control provides in one equipment the means for electronically starting, stopping, accelerating, and regulating the speed of a motor. Standard units cover motor sizes up to 5 hp. 230 volts.



System provides wide-range speed control without the use of motor-generator sets or gear and pulley arrangements. A single-dial control, mounted in a heavy-duty pushbutton station, covers the complete speed range of the motor, both above and below basic speed. Motor is automatically accelerated to preset speed without excessive current peaks. Same dial can be used to change speed to any desired value during operation.

Can be provided for reversing service by the addition of a standard magnetic reversing switch. Can be furnished also with dynamic braking. Thermal overload relay protects the motor on sustained overloads. Fuses provide d.c. short circuit protection.

Compact and easily mounted. Control station may be located accessible to the operator, thus allowing complete control of a machine from one location. Thyratron tube panel can be furnished in various types of inclosing cases, such as those for corrosive or dusty atmospheres. General Electric Co., Schenectady.

Odor Adsorber

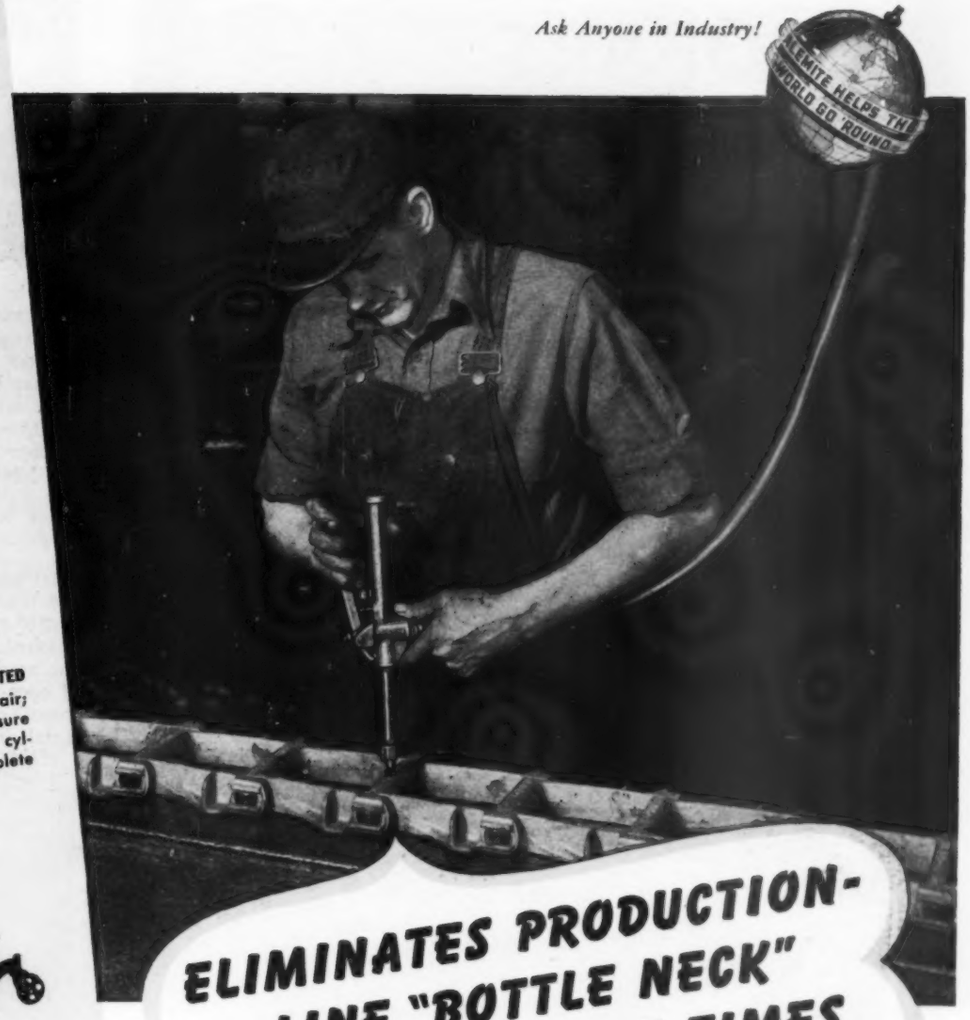
Air in a room or inclosure, which is contaminated by odors or certain gases, can be drawn into the Dorex Odor Adsorber by a fan, then drawn through an effiicient dust filter, and then through a bed of highly activated specially processed coconut shell carbon before being returned to the room. Carbon captures odor or gas and holds it through what is known as adsorption. Odor or gas cannot escape. All impurities remain in adsorber and only clean, odor-free air is discharged. Carbon can be reactivated, upon satura-

Ask Anyone in Industry!

MODEL 6700 BARREL PUMPS
Comprise a complete heavy-duty range of pneumatic pumps, available for high, medium, or low pressures. Handle heavy greases direct from drums.

MODEL 6184 25-LB. AIR-OPERATED
Operates on 80 to 100 lbs. air; develops 33 times air pressure used; nitralloy piston and cylinder; easily portable; complete with hose and adapters.

MODEL 6528 40-LB. AIR-OPERATED
Operates on 100 to 150 lbs. air; handles heavy fibrous grease at 33 times air pressure used; exclusive helix arm and worm assures positive prime, no air pockets.



ELIMINATES PRODUCTION-LINE "BOTTLE NECK" WHILE SAVING 5 TIMES OWN COST IN ONE YEAR!

SAYS CHAIN BELT COMPANY, MILWAUKEE

Alemite Power Equipment speeds up chain link lubrication, eliminating pile-up on production line

"BY SPEEDING UP the lubrication of chain links, Alemite Power Lubricating Equipment has helped us eliminate a production-line 'bottle neck,' while at the same time *saving us 5 times its cost in one year,"* says the Chain Belt Company, Milwaukee.

As a manufacturing executive, you are vitally interested when *any* equipment saves 5 times its cost in one year, *while speeding up production*—particularly when it is equipment which may fit into *your* operations.

Production stepped up—maintenance costs reduced—expensive machines safeguarded—safety conditions improved—*these are only a few of the benefits* which industry reports as resulting from the use of Alemite Lubrication Equipment. Write to us about your lubrication requirements!

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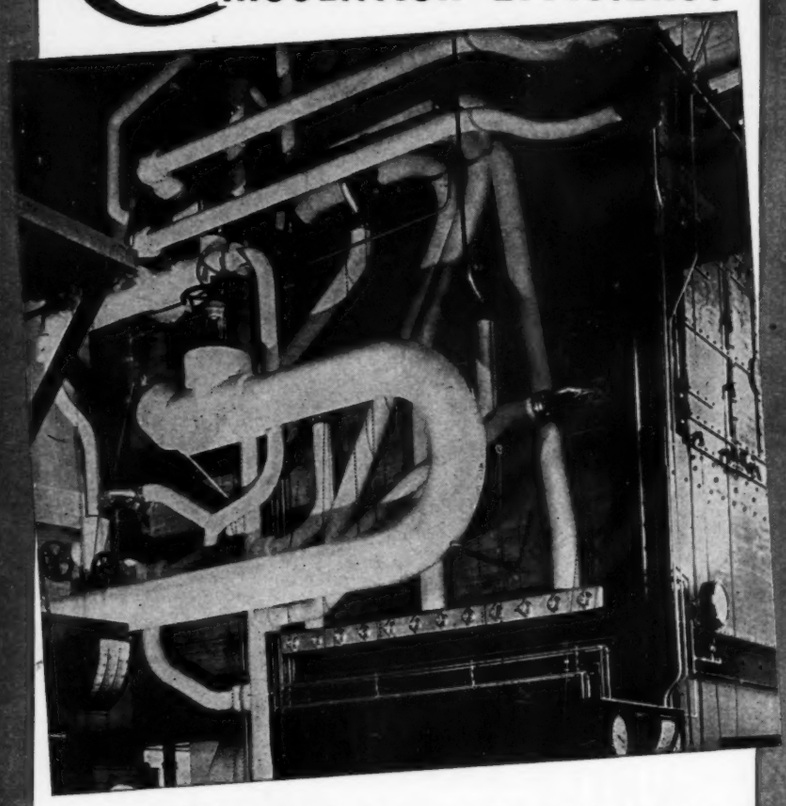
• HOBART

CHAMPION OF KITCHEN EFFICIENCY . . . . . GOES TO

Carey FOR INSULATION EFFICIENCY



The Hobart Manufacturing Company, Troy, Ohio, is widely known for the high efficiency of its food choppers, slicers, mixers, dishwashers, and other equipment for institutional and industrial requirements.

Apostle of efficiency for the kitchen, this progressive company likewise believes in top efficiency in its own production, as indicated by its selection of CAREY Insulations for its new boiler facilities, recently installed.

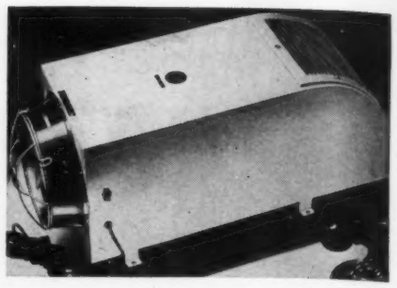
CAREY Insulations are reducing heat losses and saving fuel for many of the foremost manufacturers throughout the nation. Whatever your insulation problem, you can rely on CAREY Products and experience for maximum results. Write for Insulation Catalog—address Dept. 31.

THE PHILIP CAREY MFG. CO.

Dependable Products Since 1873

Lockland, CINCINNATI, OHIO

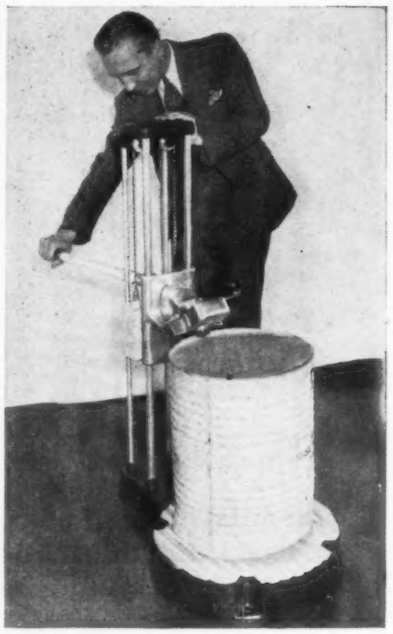
IN CANADA: THE PHILIP CAREY COMPANY, LTD. Office and Factory: LENNOXVILLE, P. Q.



tion, by a special process, and used over and over again. Available in self-contained units designed to handle certain definite degrees of odor contamination, or may be built into air-conditioning systems where they permit much of the conditioned air to be re-circulated. W. B. Conner Engineering Corp., 114 E. 32nd St., New York.

Drum Opener

Semi-automatic drum opener, known as the Westco, is characterized by speed and ease of use, simplicity of construction, and elimination of the injuries associated with the usual hammer-and-cold-chisel method of opening drums, it is claimed. Cuts a smooth-edged opening in straight-chime metal drums up to 35 inches in height.

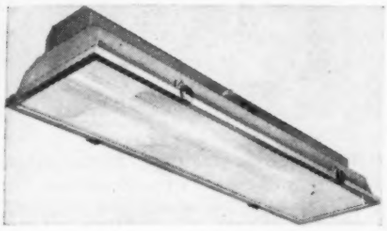


The corrugated cast-iron base can be bolted to the floor. Four steel uprights support the cutting unit, which is counterbalanced for easy adjustment to the height of drum. After adjustment, the cutting unit is locked in position. By closing the cutting unit lever, the drum is perforated. Over-all height is 50 inches. The Turner & Seymour Manufacturing Co., Torrington, Conn.

Fluorescent Luminaire

A 40-watt fluorescent luminaire, known as type FPS-40, uses 2 or 3 40-watt fluorescent lamps per reflector. Provides

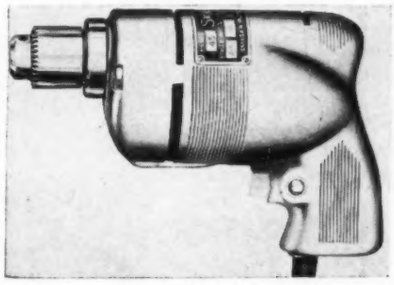
lighting intensities of from 30 to 100 foot-candles with maximum diffusion, minimum glare, and uniform distribution at ordinary spacing and mounting heights. Gives adequate visibility for close work, such as reading precision micrometers, verniers, and other shop instruments.



Design of luminaire makes it possible to construct any length of strip desired from four simple and compact types. Channels provide a continuous wireway which may be mounted on conduit, messenger cable, twin-rod suspension, or directly on the ceiling. All auxiliary equipment is mounted in the channel. Units have twin-ballasts with built-in compensators providing power factor of 90 percent or over. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

One-Quarter Inch Drill

A ¼-in. drill suited for fast production drilling because of its compactness, light weight, balance, and ready power. Weighs 2¾ lb., is 6⅝ inches long over-all, and 2 $\frac{9}{16}$

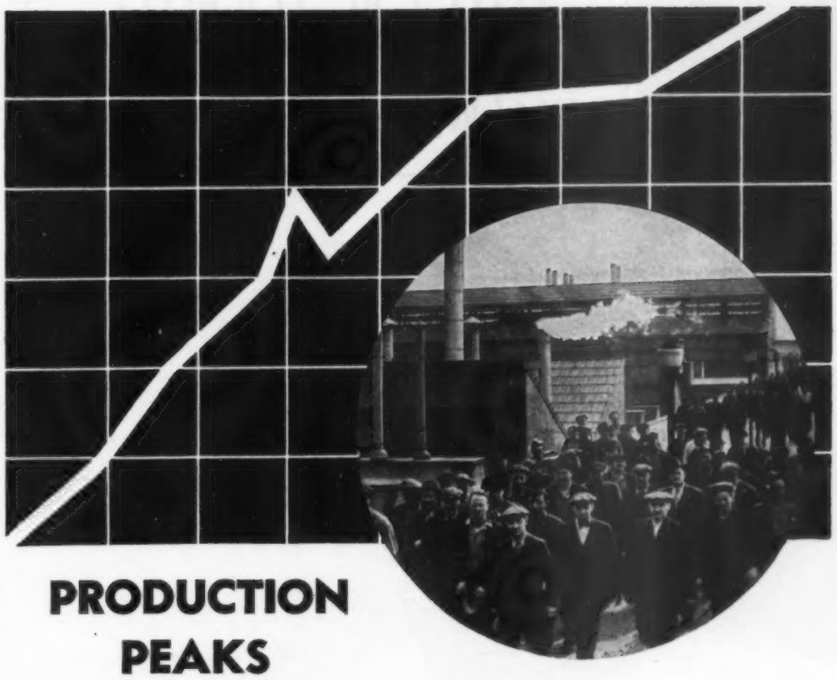


inches wide. Fits in the palm of a man's hand for drilling in tight spots. Has a no-load speed of 1,800 r.p.m. and a full-load speed of 1,050 r.p.m. Drilling capacity in steel is ¼ inch and in hardwood ½ inch. Skilsaw, Inc., 5033-43 Elston Ave., Chicago.

Crane

One-man, one-motor operated, pneumatic-tired wheel mounted crane, known as Model 205 WM has recently been announced. Of the 6-ton class this model has a wide range of speeds, hydraulic steering, mechanical hydraulic brakes on rear wheels, and other features that lend to its mobility and usefulness.

Clark truck type transmission is provided on the deck, driven by roller chain, and powered through a Lipe clutch. Deck transmission is arranged with four speeds and reverse. Gearshift lever is located beside the operator. Clutch is operated by an automotive type foot pedal. Chassis transmission is mounted between the frame I-beams, and has a three point



PRODUCTION PEAKS

demand efficient workers

War-conditioning to keep our Country great, free, powerful and happy demands production peaks of every useful industry. Where employees can labor comfortably and healthfully, they work at top efficiency and achieve production peaks. Only with modern methods of heating, ventilating and air conditioning will employees' efficiency and morale best meet the strains of the day.

How well are you personally equipped to judge what is needed to guard your interests by conserving man-power?

There is no better way to fit yourself to act wisely and promptly on these pressing problems than to visit the 7th International Heating and Ventilating Exposition—the Air Conditioning Exposition—at Philadelphia in January.

Be sure to visit this outstanding biennial event so you can act with greater assurance and confidence. You owe that to your business, your associates, your Country and yourself.

7th INTERNATIONAL HEATING & VENTILATING EXPOSITION

The Air Conditioning Exposition

COMMERCIAL MUSEUM • PHILADELPHIA • JANUARY 26-30, 1942

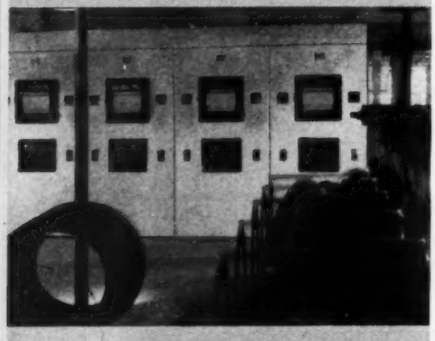
Under the Auspices of American Society of Heating and Ventilating Engineers

MANAGED BY INTERNATIONAL EXPOSITION COMPANY 776-B

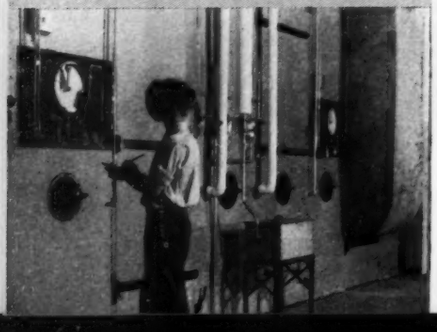
"GREEN HANDS"

Hold Rejections to a Minimum!

Sub-standard batches can be virtually eliminated when continuous annealing is under Foxboro Temperature Control.



With Foxboro Temperature-Humidity Control on rayon dryers, only a simple setting of the instrument is required to produce uniformly fast, safe drying.



If you're worried by a high rejection rate that's due to workers' inexperience, here's something you can do about it!

Equip your critical operations with automatic Foxboro Measurement or Control Instruments, and you'll give operators *exact guidance* to replace guesswork and uncertainty. After only brief training, "green hands" can "take over" exacting tasks... produce uniform results... hold rejections to a minimum. Even "old hands" work with greater accuracy and assurance!

To many industries hard-pressed by defense contracts, these instrument installations have proved the speediest, most effective way to gear plants to new inflexible specifications and schedules. Foxboro Instruments not only reduce spoilage and relieve supervisory problems, but keep production rolling smoother, faster, all along the line!

Learn what Foxboro can do for your plant. Write for recommendations on any troublesome production step involving controlled Temperature, Pressure, Flow or Liquid Level. **The Foxboro Company, 24 Neponset Ave., Foxboro, Mass., U. S. A.** Branch offices in principal cities of United States and Canada.

FOXBORO

Reg. U. S. Pat. Off.

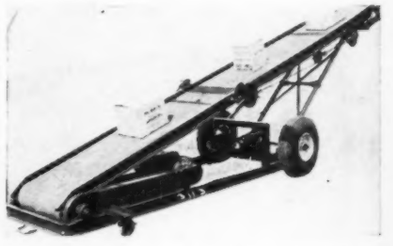
MEASUREMENT AND CONTROL SYSTEMS

suspension to prevent operating strains from being imposed upon the case. Through the speed change gears in this transmission, two additional speeds are available, giving a speed range from .86 miles per hour to 10 miles per hour. Brakes are mechanical hydraulic type, operated from operator's position in the cab. They can be applied with the cab in any position over the chassis. The brakes may also be set from the ground, when working.

An independent boom hoist may be provided on the machine, and is a complete unit mounted in the upper part of the gantry. It is operated by twin-disk clutch, with final drive through bevel gears, and a worm and worm wheel for safety. A brake is also provided to keep the boom from running down under heavy loads. The Osgood Co., Marion, Ohio.

Portable Belt Piler

Reversible portable belt piler with rubber-tired wheels designed for piling, loading, and unloading box cars. Rubber-tired wheels make it possible to move the machine from one site to another by simply hooking its lower end to a motor



truck. Casters are rubber covered so that the piler moves easily. Carrier is raised and lowered by a crank on the side. Has a safe maximum piling height of 8 feet. Minimum piling height is 4 feet. Provided with a rough top belting to keep commodities from slipping when set for the high elevation. Standard Conveyor Co., North St. Paul, Minn.

Mercury Lamp

Designated as the 3,000-watt G.E. Mazda "AH-9" mercury lamp and rated at 120,000 lumens, long tubular light source is eight times more powerful than the present largest lamp of its kind. Yet it is only 55 inches long and measures a speck more than 1 inch in diameter.

Specially suitable for lighting steel mills, foundries, erecting shops, and other large

Study of Fastening Methods May Conserve Man-power, Lower Unit Costs

More attention paid to fastening methods, and the testing of present methods against possible improvements, often result in savings which amply repay both the time spent in research and the cost of new, more efficient equipment.

Factors ordinarily observed, in making a "fastening-analysis" of assembly line efficiency, include time-and-motion recordings, worker fatigue, possibility of substituting automatic machine methods, as well as the physical tests of the fastening itself, such as tests for resistance to vibration, pull-out, shear, etc., varying with the particular fastening problem.

Solutions of fastening problems may be very simple — such as the substitution of Bostitch stapling hammers instead of ordinary hammers and tacks, a change which has saved as much as 45% of assembly costs in certain upholstering and covering operations.

In other cases, such as in the fastening of metals to metals, or to other materials, the application of the steel-stitching or stapling method may eliminate certain operations entirely. For instance . . .

Bostitch Steel-Stitcher Saves $6,250 per Year in Assembly of Vacuum Cleaners

Formerly this manufacturer, attaching disc flanges to metal cylinders, had to punch holes before riveting. A Bostitch steel-stitcher, with a Bostitch-engineered attachment for stitching on the *inside* of the cylinder, now makes punching unnecessary. Savings in cost per unit will total $6,250 a year.

Other manufacturers have effected similar savings . . . one of them saving ⅔ of labor costs with a $100 machine . . . another getting back the cost of 5 machines in only 10 days! For further information and case studies applicable to your industry — particularly if you are now engaged on defense orders — write to BOSTITCH, 60 Blackmore Street, East Greenwich, R. I.

Here's a new and larger Bostitch Self-feeding Hammer (Model H-3), driving a heavier ¾-inch staple — *one hand, one blow* — as fast as you can flick your wrist. *At present exclusively allotted for defense needs* . . . for other work when these have been met.

★ ★

HAMMERING FOR PRODUCTION, TOO

MODEL B8-H BOSTITCH HAMMER
Tack Hammer Size

Another new and smaller Bostitch Self-feeding Hammer! Drives light ¼-inch staples . . . lightning fas- . . . for labelling, posting, decorating. Adds ten inches to your stapling reach.

MODEL H-2 BOSTITCH HAMMER
The Ten-Year Tested Hammer

Proved by thousands of users . . . on thousands of different applications . . . without an equal on countless types of work. Self-feeding. On defense work, right now . . . speeding up hundreds of important jobs.

FOR ANY FASTENING JOB
To replace sewing, gluing, tacking, riveting, spot welding

★ ★ ★ ★ ★ ★ ★

"BOSTITCHING" means: the right stapling, tacking, or wire stitching machine out of nearly 800 models . . . and the right staple or wire . . . to get you the right results most efficiently and economically. These three Bostitch Hammers represent twenty years of experimental work, are examples of Bostitch Engineering that is always available to help you solve your fastening problems. Forty years of experience, plus a trained field organization of 350 men specializing in this work, are helping modern industry to *"fasten it better with wire."*

BOSTITCH
fastens it better with wire
STAPLING · STITCHING · TACKING

MAKE YOUR PLANS *NOW*

Bostitch equipment available for any defense work . . . some for civilian needs. Information for immediate or future application promptly furnished. Send samples of work to be fastened. Bostitch, 60 Blackmore St., East Greenwich, R.I.

An urgent need in Defense production

Hot foods Hot soup Hot coffee for workers

Here's the low-cost way to provide them

Showing 5 food-pan assembly in vacuum-insulated carrier.

4 standard sizes.

AerVoiD portable vacuum insulated food, soup and... coffee carriers

Vacuum-insulated soup and coffee carriers.

6 standard sizes.

After all, Defense Production narrows down to keeping man-power on the job!

To that end factory managements are beginning to concern themselves with hot foods and beverages for workers . . . something more energizing than "cold lunches" to keep workers fit and to offset production-lag. They realize that both good will and good work are enhanced by hot foods for workers.

for servicing anywhere about the plant, indoors or outdoors

AerVoiD vacuum-insulated food, soup and coffee carriers step into this picture and do a job no other equipment can do. Hot foods and beverages can be kept hot for hours in AerVoiD vacuum insulated carriers, even though transported miles in outdoor cold-weather temperatures. No installation, low first cost, practically no operating cost, affording "throughout the plant" service, one building or 20 acres of buildings. Nearly 100 Defense Plants already use AerVoiDs to supplement cafeterias, to service hot foods without cafeteria set-ups. Write today for illustrated literature.

VACUUM CAN CO.
25 S. Hoyne Ave., Chicago, Ill.

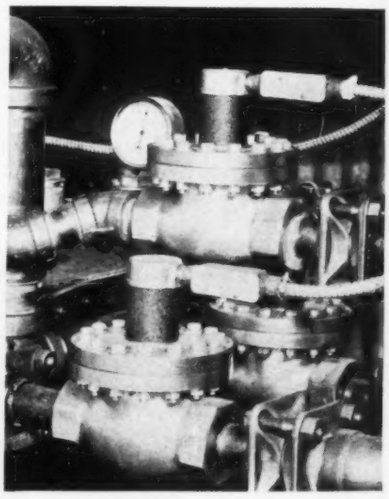
AerVoiDs...keeping American man-power on the job

areas where lofty mounting heights of luminaires are required.

In good reflectors and on conventional spacing centers this lamp can provide more than 50 foot-candles of light evenly over the working plane. General Electric Co., Nela Park, Cleveland.

High-Pressure Valves

Atkomatic valves, for operating pressures up to 3,000 lb., are made in sizes ¼, ⅜, and 1½ inches and can be furnished for standard currents. Valves are bronze, packless, with renewable seats and disks, and rugged, screwed ends. Seat diameters



can be furnished up to full pipe size. Bubble-tight pilot assembly can be furnished for air and gas operation. E. C. Atkins & Co., 402 S. Illinois St., Indianapolis.

Vibratory Feeders

Electromagnetic vibratory feeder conveyors, Model F-4 and Model F-5 have respectively capacities of 100 tons and 500 tons per hour of material. Model F-4 carries feeder pans as wide as 36 inches and as long as 60 inches in size, while Model F-5 can be supplied with troughs as wide as 48 inches and from 60 inches to 90 inches long.

Vibrated at high speed by a pulsating

A FILE helps to keep it on the beam

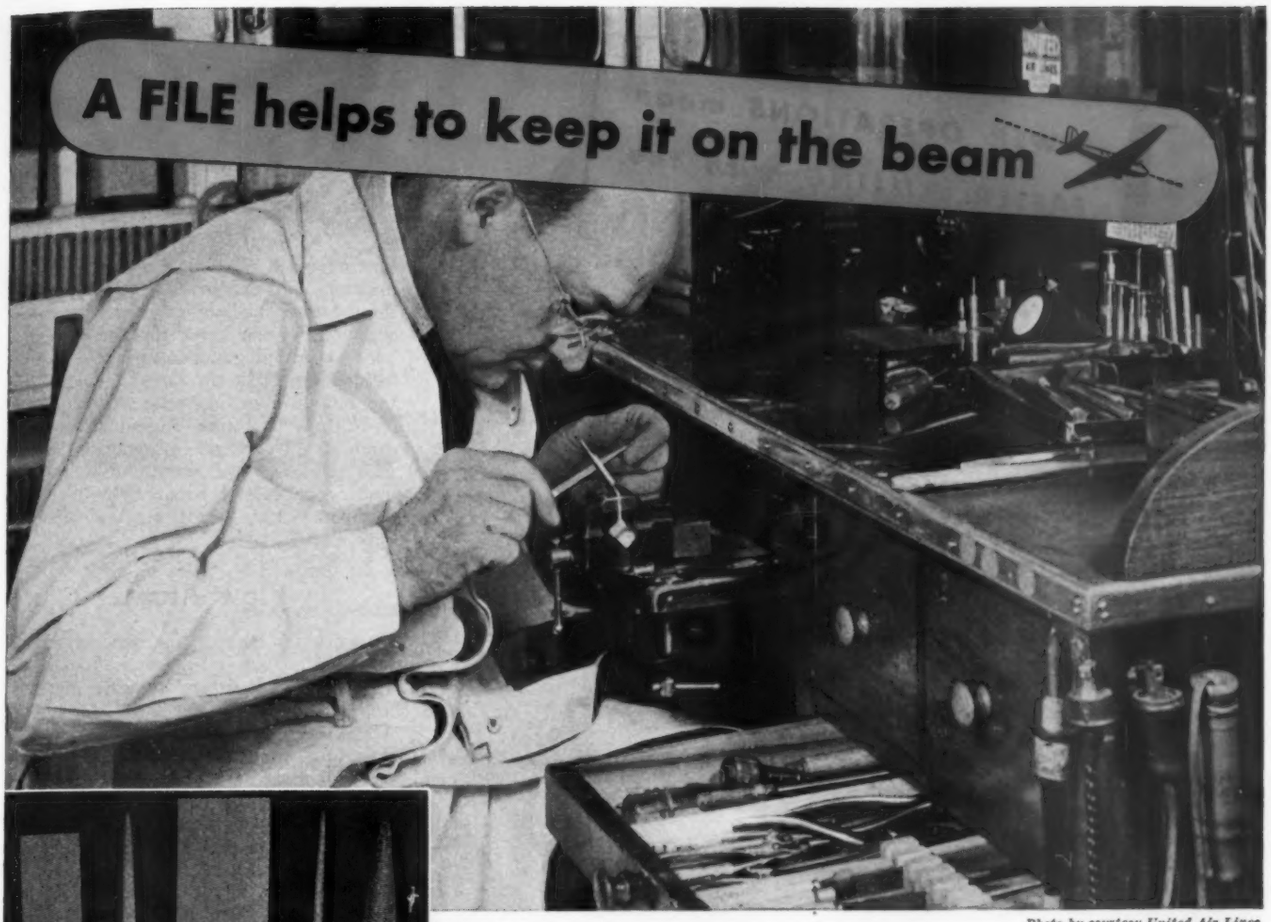
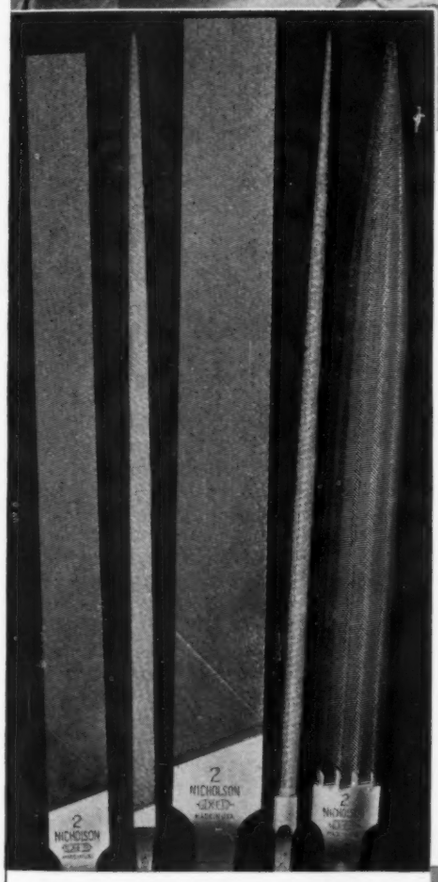


Photo by courtesy United Air Lines



• Five popular shapes (shown about 2/3 actual size) of Nicholson Die-sinker Files in Swiss Pattern. Points are smaller, tapers longer, cuts finer than in the conventional "American Pattern" files for similar purposes. Cleaning out, burring, enlarging small holes, shaping and finishing extra-narrow grooves, slots, notches and keyways are more readily accomplished.

"LET'S GO! U.S.A." "KEEP 'EM FLYING!"

The automatic pilot of a modern transport plane is an instrument of almost uncanny performance. Keeping it in perfect tune calls for precision skill—and precision tools. Here you see an instrument expert using a Nicholson File on a delicate pilot part. It is a precision file. It is made with a keen yet silken-smooth bite that is possible only under ***exacting manufacturing standards*** and ***long experience*** . . . Nicholson heritages which enable Nicholson and Black Diamond Files to carry the extraordinary guarantee of ***Twelve perfect files in every dozen.***

Among the current heavy demands for Nicholson Files, one of the heaviest is for Nicholson X. F. (Extra Fine) Swiss Pattern Files . . . for the aircraft, automotive, die-making and fine-instrument industries particularly.

The world's largest file manufacturing plant is at peak capacity in turning out these fine files. Consult your mill-supply house.

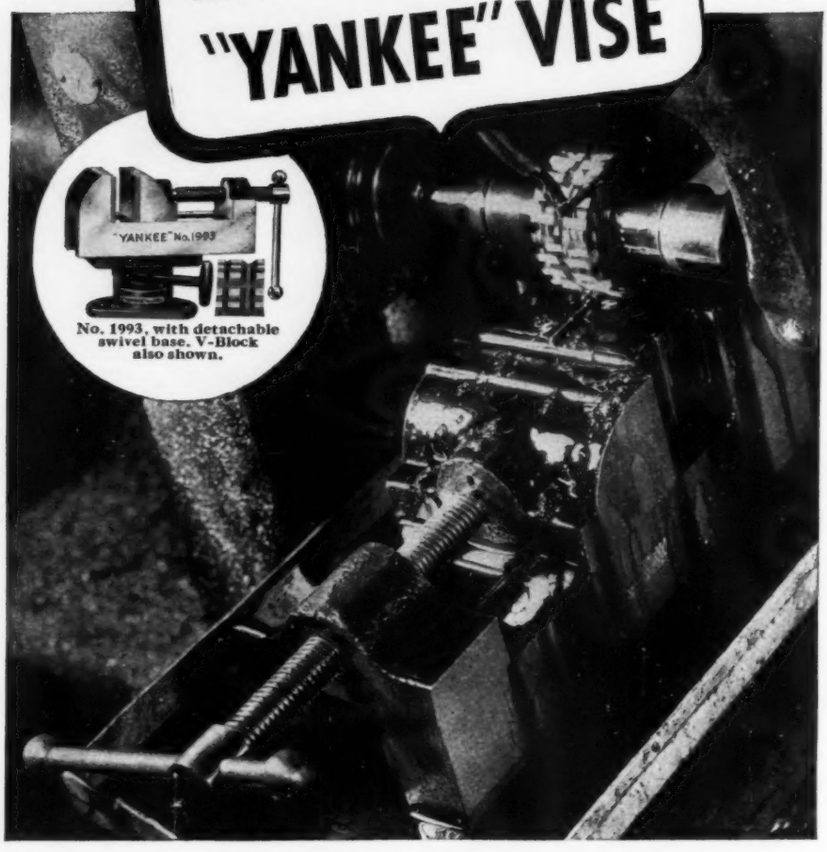
NICHOLSON FILE CO., Providence, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

FREE TECHNICAL BULLETINS *and catalog information on X. F. Swiss Pattern, Die-cast, Aluminum, Brass, Stainless Steel, Foundry, Plastics, Shear Tooth and Long Angle Lathe Files. Write us for copies of Bulletins you want.*

NICHOLSON FILES
FOR EVERY PURPOSE

NICHOLSON U.S.A. MADE IN U. S. A.

FEWER OPERATIONS mean
FASTER MILLING with the
"YANKEE" VISE



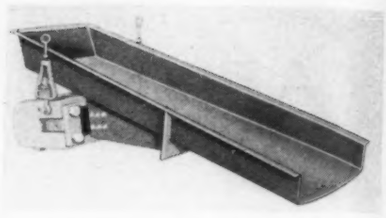
No. 1993, with detachable swivel base. V-Block also shown.

Cut out waste motions—they are costly and time-consuming! The "Yankee" Vise is designed to speed production. Once work is squared on face plate or machine bed it *stays* squared because the sides, front end and base of the "Yankee" Vise are accurately machined. If work must be moved from bench to drill press or milling machine, it can be done quickly and easily without realignment. The same vise can be used for round stock, simply by inserting a hardened steel V-block that's furnished as standard equipment. All these "Yankee" features save time and production costs.

Order from your supply house . . . or write North Bros. Mfg. Co., Dept. FMM, Phila., Pa., U.S.A.

"Yankee" Vises are made in four jaw widths and two styles. No. 991 —1½"; No. 992—2"; No. 993—2¾"; No. 994 —4". These same sizes with the detachable swivel base feature are Nos. 1991, 1992, 1993, 1994.

"YANKEE" TOOLS
make good mechanics better
NORTH BROS. MFG. CO., Phila., U.S.A.



electromagnet. The exclusive, patented principle of energizing these magnets through the medium of a rectifier tube accomplishes the heavy tonnage capacity.

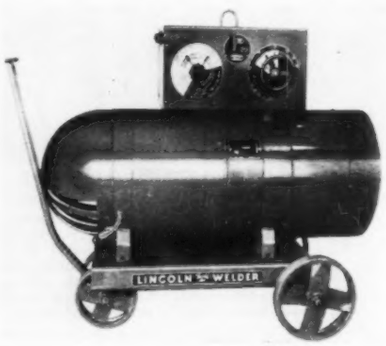
Major advantages claimed by the manufacturer are finger-tip rheostat control of the rate of flow, permitting a range of feeds from a rushing torrent to a slow dribble, and absence of moving parts, such as gears, cams, screws, disks, rollers, idlers, connecting rods. The Syntron Company, 480 Lexington Ave., Homer City, Pa.

Flow Alarm

Designed for high or low pressure service on water, oil, gas, or line applications when a signal is needed to indicate starting, stopping, or insufficient flow, features of Magnetrol flow alarm include: Magnetic operating principle that eliminate the use of stuffing boxes, bellows, diaphragms, or rotary shafts to gain switching action; installation can be made any place where an ordinary check valve will operate; operation is not affected by the presence of vegetation in the water. Units are available in a complete range of standard pipe sizes up to 4 inches. Standard equipped mercury-to-mercury electrical switch is rated at 15 amps., 125 volts, 10 amps., 250 volts. Fred H. Schaub Engineering Co., 325 W. Huron St., Chicago.

Arc Welder Control

Improved and simplified design of system of "dual continuous control" for arc welding machines which eliminates the need for meters showing volts and amperes is announced. Welders have both job selector and current control calibrated and equipped with dials which indicate the type of work and the number of amperes for each and every setting. It is claimed that this feature enables the welding operator to secure highest quality welds and lightest possible welding speeds, because he can vary both the slope of the volt-ampere curve and the amount of weld-



Production • • •

Day and night BWH is producing mechanical rubber goods. Thru our distributors many of these products reach factories running largely on defense work — as well as army cantonments, naval stations and Government flying fields.

Because of national defense requirements our stock of mechanical rubber goods may not be as complete as in normal times. Faced with emergency demands, we naturally cannot replenish our stock as promptly as formerly.

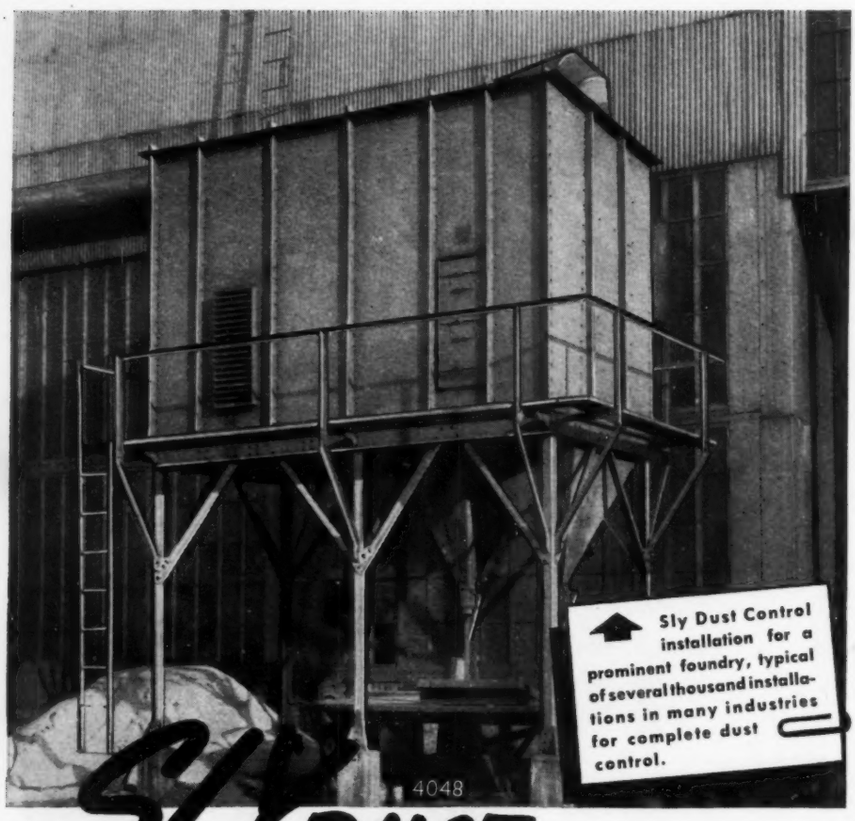
We ask our customers to bear with us and to be confident that we are trying in every conceivable way to produce their requirements as rapidly as possible.

We naturally regret losing business as much as you do . . . because volume business means ideal operating conditions . . . and because we consider our customers as our most valuable assets.

Production battles are not won by factories or machines alone. They are won by morale . . . by the courage and spirit of both workers and management to get things done. Customers' morale helps, too.

BOSTON WOVEN HOSE AND RUBBER COMPANY

WORKS: CAMBRIDGE, MASS., U. S. A. ★ P. O. BOX 1071, BOSTON, MASS., U. S. A.


Sly Dust Control installation for a prominent foundry, typical of several thousand installations in many industries for complete dust control.
4048

SLY DUST CONTROL

Is Helping Industry Get Top Production

★ *Defense operations demand clean plants. Good working conditions for employees is one of the most important considerations today in meeting the demands for production and more production.*

SLY Dust Control is inexpensive insurance against health hazards—against lost time. It enables men to work to better advantage—to accomplish more. Thousands of users find in Sly Dust Filters certain exclusive advantages:

(1) Greater filtering capacity because of more filter cloth.

(2) Less maintenance due to simpler shaker mechanism.

(3) Bag replacement easily handled.

(4) Complete dust removal with minimum resistance to air flow because of filter bags under tension.

(5) Automatic control (any degree).

These features help enormously in efficient operation.

Write us fully. We will analyze your situation and tell you exactly what can be accomplished. Sly Dust Control pays for itself.

THE W. W. SLY MANUFACTURING CO.

Branch Offices in Principal Cities

4755 TRAIN AVENUE CLEVELAND, OHIO

SLY
INDUSTRIAL DUST CONTROL

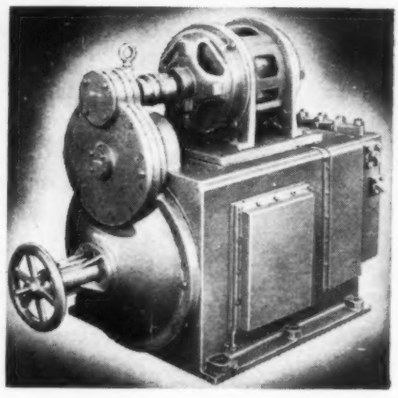
ing current independently and positively to suit every job encountered.

Another feature of this welder control is that both voltage control (job selector) and current control are continuous in operation which provides thousands of possible combinations of voltage and current.

An advantage made available by this development is the ability to reverse polarity. Reversing switch has been placed immediately above and between the self-indicating dials. Settings of the reversing switch for "off," "electrode negative," and "electrode positive" are indicated by markings on a disk attached to the control box. The Lincoln Electric Co., 12818 Coit Rd., Cleveland.

High-Pressure Pump

With the variable delivery, high-pressure pump that has been built recently, flow is infinitely variable from 0 to 6 g.p.m. at 5,000 lb. per sq.in. pressure. This is accomplished by a driving member trunnioned on the drive shaft; its angle can be varied while the pump is running to produce a corresponding stepless change in plunger stroke from zero to full 4-inch stroke. The stroke control shaft is extended to the outside of the pump casing for attachment either to a manual or automatic pressure control.



Especially suited to hydraulic press applications where a rapid advance must be followed by a slow movement at high pressure, and for boiler feed where sudden changes in output affecting the water level are met.

Equipped with a 25-hp. motor, mounted so that the entire unit is but 4 ft. high and requires only 4x4-ft. floor space. Weight is 5,000 pounds. Units can be built for designed pressures ranging from a few hundred to 8- or 10,000-lb. per sq. in. pressure. Watson-Stillman Co., Roselle, N. J.

Ignitron Combination Welding Timer

Especially adapted for seam and spot welding where frequent changes of timing are necessary, ignitron welding timer, known as the SX, consists of a control panel and ignitron tube assembly mounted in an inclosing cabinet. The ignitrons are essentially mercury arc rectifiers with an

New Horizons are coming into focus fast!

Anaconda quickens search for better wires and cables for American Industry and Defense

America is moving ahead at a faster pace. New industrial horizons are being reached and passed daily . . . thanks to the ingenuity of private research.

In the laboratories of the Anaconda Wire & Cable Company, for example, engineers are building longer life, greater current capacities, greater dependability in the power lines supplying electrical energy to vital defense machinery. But even when our defense goal is achieved, research will be looking further ahead . . .

Tomorrow when peace comes, Anaconda Wire & Cable Company will be ready with not only many new products, but also many product improvements for those who have been denied them during the emergency period. There will be better wires and cables available for a better and greater era of industrial progress.

ANACONDA WIRE & CABLE COMPANY
General Offices: 25 Broadway, New York City
Chicago Office: 20 North Wacker Drive
Subsidiary of Anaconda Copper Mining Company
Sales Offices in Principal Cities 41379

ANACONDA
from mine to consumer

This familiar trademark identifies Anaconda products. It symbolizes the best efforts of man and science.

ELECTRICAL WIRES AND CABLES OF COPPER ARE THE LIFE LINES OF OUR NATION

ANACONDA WIRE AND CABLE

CELLU-LINED

Hydraulic Hose for High Pressures

OIL PROOFED with CELLULOSE

Cellu-lined hose is oil-proofed with multiple layers of cellulose, a material completely resistant to hydrocarbons, i. e. — hot oils, etc.

BURST PRESSURES to 23000 P.S.I.

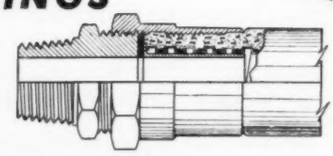
Great strength of Cellu-lined hose is obtained by imbedding metal braid covering in the synthetic casing.

SIZES 3/16" I.D. to 1 INCH I.D. (incl.)

Available sizes of Cellu-lined hose (I. D. measurements): 3/16", 1/4", 3/8", 1/2", 3/4" and 1".

CELLU-SEAL COUPLINGS

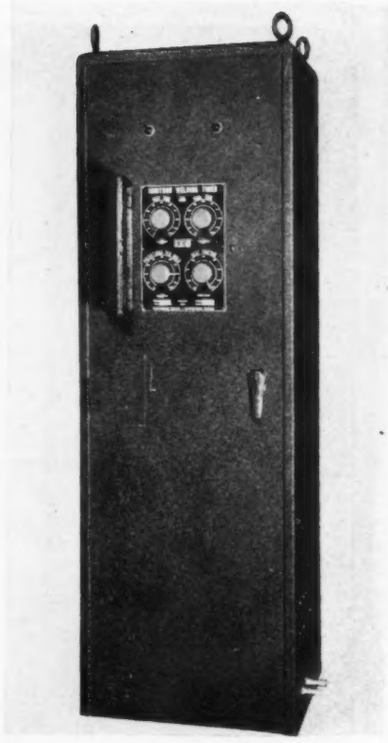
Couplings for Cellu-lined hose are available with standard I. P. T. or S. A. E. threads.



Write for Catalog and Engineering Recommendations on specific problems involving flexible connections.

CHICAGO METAL HOSE CORPORATION

MAYWOOD, ILLINOIS



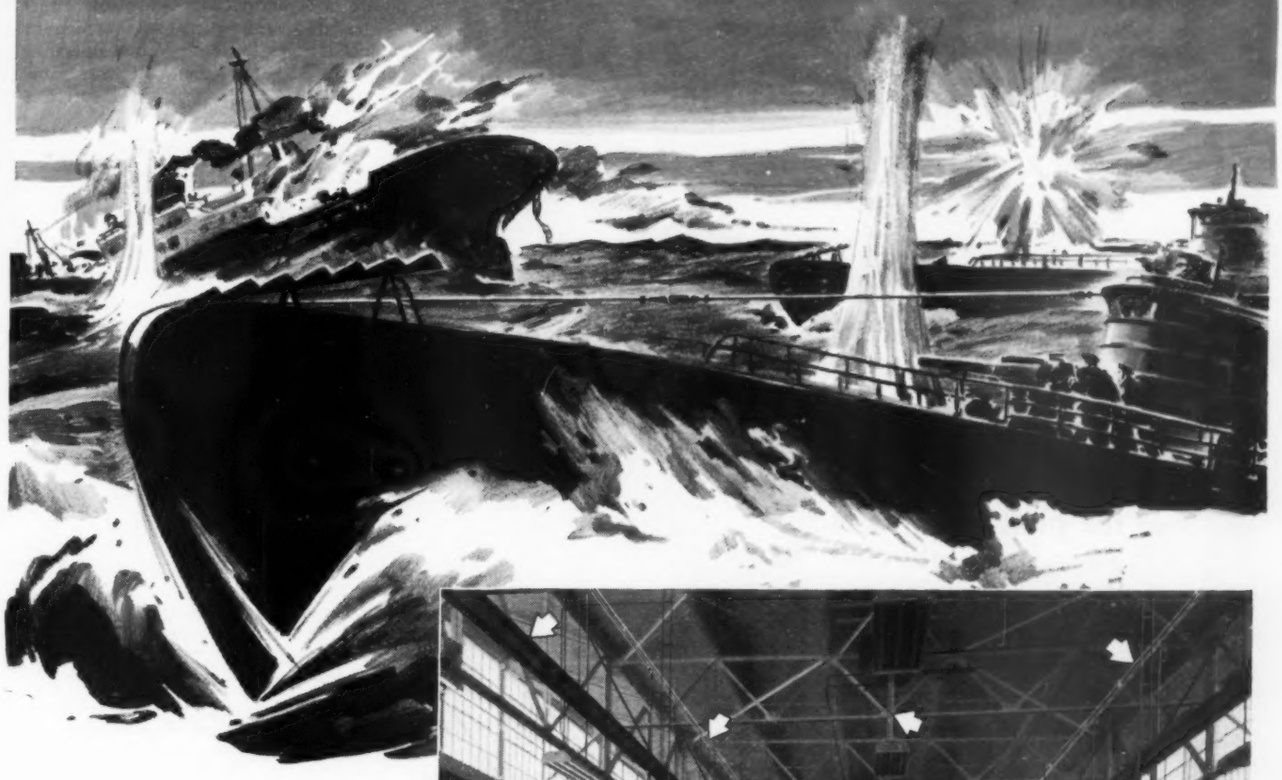
ignitron or control electrode inside. Heat of the arc is removed by a water-cooling system. Seam weld "on" or "off" timing adjustable from 1 to 30 cycle steps is provided; 1 to 15 pulsations can be made for each setting. In operating, the electronic tubes and circuits perform five distinct functions: (1) "On" timing: (2) "off" timing; (3) pulsation counting; (4) heat control; (5) firing of the ignitron power tube. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

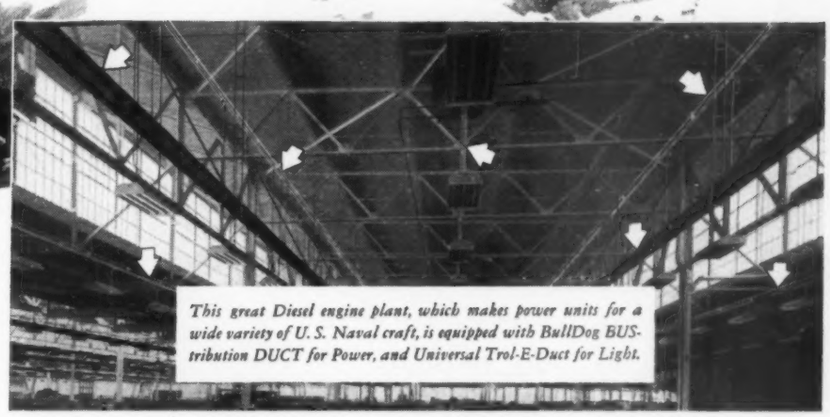
Drum and Barrel Carrier

Little Giant model drum and barrel carrier has been designed and constructed for handling literage drums which are principally used as containers of heavy materials. One man using only one hand can take the place of several men formerly required to break-over, balance, and move drums. In addition, accidents

WHILE MARAUDERS HUNT IN PACKS

BullDog "Plug-in" Light and Power Guards Vital Production Minutes for American Warship Builders





This great Diesel engine plant, which makes power units for a wide variety of U. S. Naval craft, is equipped with BullDog BUStribution DUCT for Power, and Universal Trol-E-Duct for Light.

BUILDERS for the U. S. Navy—shipyards turning out battleships, cruisers, submarines, "mosquito boats," mine sweepers and other auxiliary craft —are equipping their new plants, or modernizing their old, with BullDog Flexible Electrical Distribution Systems.

Makers of naval ordnance and equipment, too—power plants, guns and ammunition, torpedoes and depth bombs, hardware and fittings—are finding that BullDog "Plug-in" Bus Duct Systems meet their demands *for ready light and power anywhere.*

Three Systems — Used Singly or in Combination

There are three BullDog "Plug-in" Systems—BUStribution DUCT for *Power;* Universal Trol-E-Duct for *Light,* and Industrial Trol-E-Duct for *Production Lines* or *Assembly Benches.* Each system permits "plug-ins" as simply as appliances are plugged in at home; each can be used singly or in combination with the others; each is built in standardized, interchangeable sections; each is quick and easy to install or to move from one position or one plant to another; each is 100% salvable and reusable.

BullDog standard products, too — Vacu-Break Safety Switches, Light and Power Panelboards and Switchboards — are widely used in defense plants and by industry generally.

Write for Bulletins 403 and 412 describing BullDog Flexible Electrical Distribution Systems. Better yet, ask for a call from a BullDog Sales Engineer — and ask him to show you the roster of hundreds of defense plants where vital production time is being safeguarded by one, two or all three BullDog "Plug-in" Bus Duct Systems.

BULLDOG
ELECTRIC PRODUCTS CO.
DETROIT, MICHIGAN
BullDog Electric Products of Canada, Ltd., Toronto, Ontario

ORIGINATORS OF FLEXIBLE ELECTRICAL DISTRIBUTION SYSTEMS FOR LIGHT AND POWER

Master of the Air

HANSEN Push-Tite

AIR HOSE COUPLINGS

With HANSEN PUSH-TITE air hose coupling there is no waste of air, time or energy—a slight push of the plug into socket and it is not only connected absolutely air tight but the air is automatically turned on. Action right away. An easy pull back on sleeve, it is disconnected instantly and air is automatically shut off.

Hansen Push-Tite couplings are air tight, absolutely no leakage at any air pressure. No twisting or turning of parts to connect or disconnect, it's merely a matter of push and pull. Hansen Push-Tite coupling is designed so that complete swiveling action prevents kinking or twisting of hose.

Write for free catalog.

★★★

used by

U.S. ARMY NAVY

AVIATION AND INDUSTRIAL PLANTS

Hansen

MANUFACTURING CO.

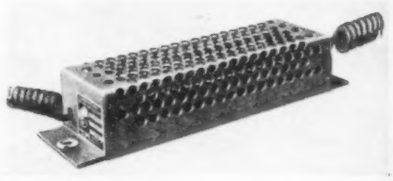
1786 East 27th St. • Cleveland, Ohio

common to handling loaded containers are prevented by simple lifting device and self-balancing tri-wheel design.

Copper silicon alloy metal wheels and locking device are available where precaution against explosions is necessary. Capacity up to 600 pounds. Ernst Magic Carrier Sales Co., 1456 Jefferson Ave., Buffalo, N. Y.

Fluorescent Lamp Resistor

Resistor Type K-40878 is for use with 6-watt T-5 fluorescent lamps on either a.c. or d.c. with a manual momentary contact starting switch. When operating lamps on 120-volt circuits resistors elimi-

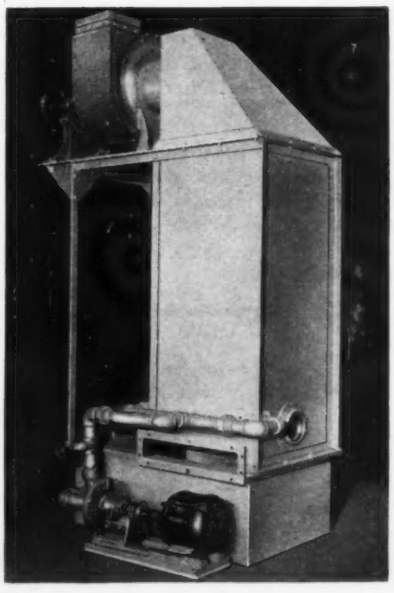


nate the need of an auxiliary. Unit measures approximately 1¾x6½ inches over-all. Can be mounted in any standard fixture or wiring trough, and insulated for 15,000 volts to ground. Ward Leonard Electric Co., 31 South St., Mt. Vernon, N. Y.

Dust Collector

Hydro-Whirl dust collector removes hazards that have attended the processing of magnesium and its alloys. Dust created by buffing, polishing, and grinding parts is effectively trapped by the functional part of this dust collector, and is brought down into a tank where it is transformed into an inactive element in the form of sludge which is later either burned or buried in the ground.

Effective for all types of metal dust. Working mechanism consists of a rotating shaft on which are centered a series of disks. The controlled rotating speed of the shafts in a horizontal plane throws a rain of water into the baffled section of



MANHATTAN RUBBER helps the flow of *Steel* into a thousand shapes—for Defense ★ ★ ★

The sparks and the glow and the lurid liquids that flow from furnace and ladle are the climax of grandeur in the saga of steel.

But this molten spectacle is but one scene in the solid drama of metallurgy where rubber plays a varied role.

MANHATTAN makes hundreds of products which help shape billet and bloom to the needs of Man as well as of Mars.

Ore and coal, coke and limestone travel from mine and quarry on rubber conveyor belts; air and water and steam are borne through rubber hose; parts are welded, sand-blasted, pickled and plated with the aid of rubber. These and an astonishing list of other products—like abrasive wheels for snagging and cutting off, and asbestos brake lining for cranes and hoists—are part of what MANHATTAN makes for the Steel Industry under the banner of Defense.

★ ★

A few MANHATTAN Products used by the Steel Industry

Conveyor Belts, Mildew-proof
Rubber Belting
V-Belts
Hose for Acid, Air, Chemicals, Sand-Blasting, Steam, Water and Welding
Fire Hose
Furnace Door Hose
Rubber-Lined Pickling and Plating Tanks
Rubber Covered Rolls
Abrasive Wheels
Brake Lining, Clutch Facings
Asbestos Cable Covering
Asbestos Products
Molded Goods and Packing
Rubber Pipe

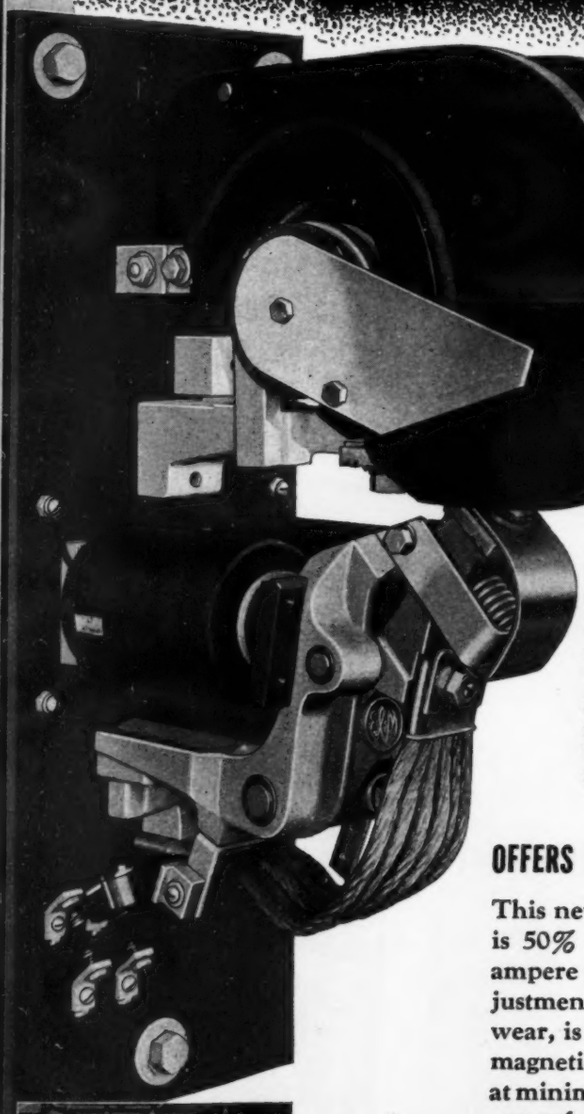
★

● A typical Manhattan conveyor belt installation in the steel and allied industries.

KEEP AHEAD WITH MANHATTAN

THE MANHATTAN RUBBER MFG. DIVISION
of RAYBESTOS-MANHATTAN, INC.
GENERAL OFFICES and FACTORIES—PASSAIC, NEW JERSEY

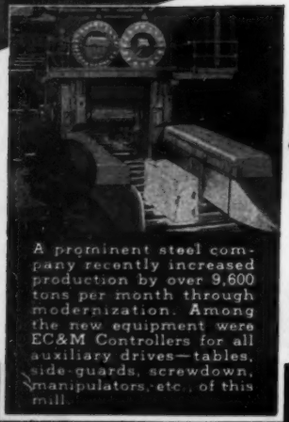
WORLD'S
FASTEST
600 AMPERE CONTACTOR
for D-C Service
TO HELP GET MORE Production



The faster response of this EC&M Contactor results in *greater accuracy* in spotting crane loads, fewer applications of down-power, reduced number of bridge and trolley motions—*faster positioning* of screwdowns, sideguards, manipulator fingers, etc. . . . briefly, *an aid to greater production in '42.*

OFFERS MANY OUTSTANDING FEATURES

This new EC&M Magnetic Contactor is 50% faster than the previous 600 ampere contactor, has a 2-position adjustment permitting over ½" contact-wear, is designed with highly efficient magnetic circuit, keeping leakage flux at minimum and inductance down, has powerful magnetic blow-out and large arc shield for highly inductive circuits, and *embodies LINE-ARC principle.*



A prominent steel company recently increased production by over 9,600 tons per month through modernization. Among the new equipment were EC&M Controllers for all auxiliary drives—tables, side-guards, screwdown, manipulators, etc., of this mill.

IT PAYS TO MODERNIZE

● Be sure to specify EC&M *Line-Arc* Contactor Control for d-c cranes and mill auxiliary drives.

THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND - - - OHIO

HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS.

the unit at which point the dust is whirled out of the air stream. Scientific calculations have attained a proper balance between the velocities of air and water. This balance insures thoroughly cleaned air which may be returned to the building. Industrial Sheet Metal Works, Detroit.

Combination Watthour and Thermal Demand Meter

Combination watthour and thermal demand meter, available in standard house size, case, and mounting, has a.c. ratings of 5, 15, and 50 amp. capacities, 120 to 240 volts, 2 and 3 wire for reading up to 20 kilowatts.

Voltage component of the thermal element is fed by a secondary coil wound directly over the potential coil of the watthour meter. This arrangement makes it possible to combine the watthour and thermal demand mechanisms into a single unit. Design of the thermal unit reduces the required operating energy. Dial and nameplate are combined with the demand scale located at the bottom of the dial. Two demand pointers are provided, one operating as a pusher, and the other to indicate the maximum demand. The latter is accurately balanced and held in position by an adjustable friction device to eliminate shifting because of vibration.

Watthour mechanism has standard adjustments for full load, light load, and power factor; thermal unit has only two adjustments, for zero and for full scale. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Air-Operated Machine Controls

Ready-made air ejection sets that can be adapted to fit the needs of any individual concern. Allow the user to step up production by using a blast of compressed air to remove the work from the machine even after an operation is completed. Obtainable in a variety of different hose lengths, blow valves, pilot valves, blast nozzles, and operating mechanisms.

Tip-toe and finger-tip control for operating machine clutches by compressed air are made up of separate controls; pilot and bleeder valves assembled with necessary

BRONZE *Bearings* FROM STOCK

● Completely machined BUNTING Cast Bronze Bearings are obtainable from stocks located in principal centers throughout the country. They are made in standardized sizes ready for assembly in machine tools, electric motors, and countless other applications. Also Precision Bearing Bronze Bars in hundreds of sizes. Ask your wholesaler. Write for catalog giving specification data. The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.

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PRECISION BRONZE BARS

HARNESSING THE WHIRLWIND!

THE BUELL DUST RECOVERY SYSTEM DOES IT... with the famous van Tongeren Cyclone, the only method of harnessing the whirlwind energy of the "double eddy current" (present in all cyclone-type collectors) and putting it to work to give you greater collection efficiency on all dust sizes.

No Other Collector Employs This Principle

Only Buell gives you the *plus* value of the van Tongeren System's greater recovery efficiency. *It saved one user $40,000 in 13 months!* Buell (van Tongeren) Dust Collectors have many other advantages . . . all good reasons why so many industrial leaders prefer Buell. Investigate!

24-page bulletin, "Dust in Industry" sent on request

buell DUST COLLECTORS

BUELL ENGINEERING COMPANY, Inc. 12 Cedar Street, New York

NATION-WIDE SERVICE THROUGH OFFICES OF EITHER BUELL ENGINEERING CO. OR B. F. STURTEVANT CO.

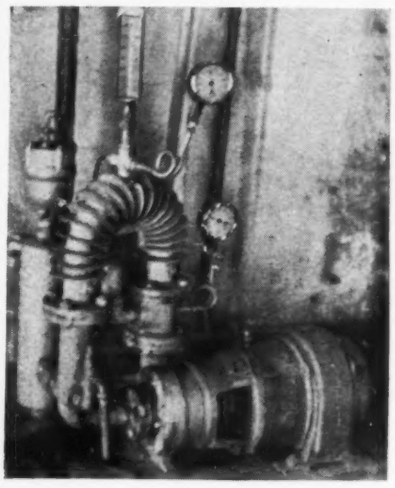
hose lengths to fit on machines by merely drilling a minimum of bolt holes.

With the hand-operated control sets, safety is accomplished by a patented cut-out unit which makes it necessary for the operator to remove both his hands from the work to operate the machine—making sure they are out of the danger zone when the ram comes down.

Heavy-duty air-line coupler is especially constructed to give a kink-free service connection for compressed-air hose to air-driven tools. With couplers such as these compressed air can be piped through a plant and tapped at will, thus making compressed-air outlets as accessible as electric outlets. A. Schrader's Son, 470 Vanderbilt Ave., Brooklyn.

High-Pressure Condensate Return System

Engineering features claimed for the Cochrane-Becker high-pressure condensate return system are that its eductor principle of operation insures thorough condensate and air removal from process apparatus, making increased production possible by maintenance of uniformly high tempera-

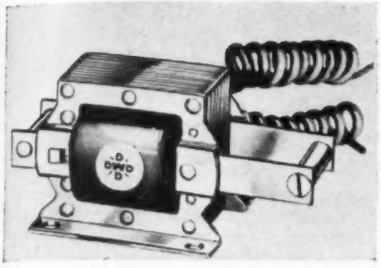


tures. Then, after expulsion of the air from the closed circuit, the condensate is returned to the boiler at temperatures close to that of process pressure without flash loss and with fuel savings.

Specially designed centrifugal pump draws water from the thermo-fin priming loop and discharges it as a high velocity jet through the jet pump nozzle. This jet, striking the returned hot condensate, induces condensate flow through the mixing tube into the thermo-fin priming loop. The additional volume of the returned condensate introduced into the constantly filled loop results in the discharge of an equal volume through the air separator to the boiler. Cochrane Corp., 17th & Allegheny Ave., Philadelphia.

Laminated Solenoid

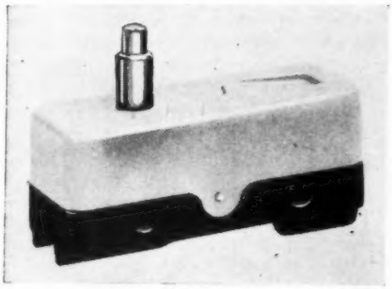
Compact design and sturdiness mark a laminated type solenoid for constant or intermittent duty on alternating current. Furnished with either push or pull type plungers. Field coil is paper-section



wound, taped, and specially treated to be impervious to cutting oils. Measures 2x2 inches with a plunger stroke of ¾ inch and can be obtained for any voltage. Has minimum push or pull of 5.5 lb. at full line voltage, and 3.75 lb. at 85 percent of line voltage. Dean W. Davis & Co., Inc., 549 W. Fulton St., Chicago.

Overtravel Type Switch

Overtravel type switch has recently been placed in production. Overtravel of at least 1/16 inch is provided though the amount of this used for actuation remains at 1/1000 inch, as in the standard pin plunger type.



Features include rolling spring principle which makes possible millions of positive, frictionless makes and breaks. It also provides high operating frequency and high contact pressure. Specifications: 10 amp. 115 volt a.c., maximum wattage 1000; 5 amp. 250 volt a.c., maximum wattage 1000; 3 amp. 450 volt a.c., maximum wattage 1000. Pressure, 2 to 14 oz. Weight, approx. 1 oz. Size, 1 15/16x11/16 x27/37 inches. Acro Electric Co., 3152 Fulton Rd., Cleveland.

Pump

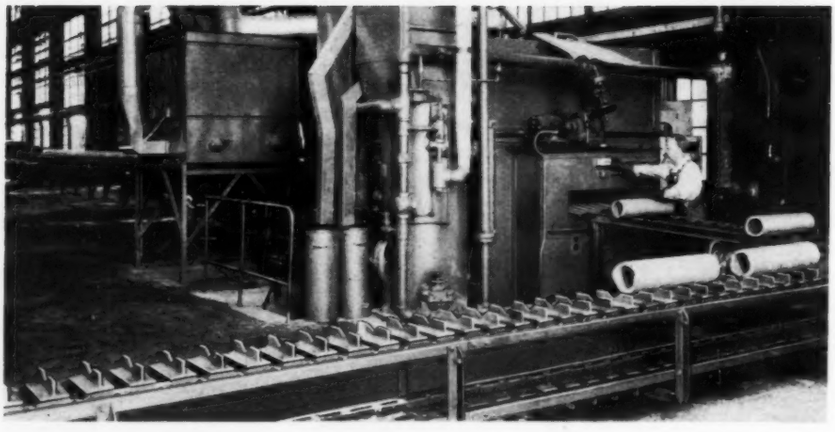
Operating on a "squeegee principle" pump consists of a flexible rubber tube which is alternately squeezed and released in a rocking, squeegee manner so that the liquid or gas is actually breathed into and out of the tube. Liquid or gas being pumped is totally inclosed within the tube, from the time it enters the pump until it leaves, thus it cannot come in contact with any metal part of the pump. Tube can be made of pure gum rubber and various acid and oil resisting synthetic materials. Cleaning or sterilization is easy and does not require taking the pump apart. Solutions containing solids, whether abrasive or otherwise, cause practically no wear, since the inside of the tube is a smooth, continuous surface, with no projections, corners, crevices, or similar vulnerable places. Pump is noiseless in operation, has a high efficiency and

The *new* CM Meteor heavy-duty wire rope electric hoist is industry's newest recruit for speeding-up production. It is designed, engineered and built to answer the nation-wide demand to produce more and faster. Featuring true balance, streamlined design . . . aeroplane type cooling . . . helical gears and one point lubrication, the CM Meteor provides fast materials handling with complete safety. Compact . . . low head room . . . readily adaptable to present systems. Only 110 volts pass through the push button station. The Meteor really *smashes* bottlenecks by speeding up materials handling.

Completely illustrated engineering Catalog No. 142 in color, showing details, specifications, applications and point by point advantages of the CM Meteor will be sent on request. Write:

CHISHOLM-MOORE HOIST CORPORATION
(Division of Columbus-McKinnon Chain Corp.)
120 FREMONT AVE. TONAWANDA, N. Y.
Branch Offices: NEW YORK • CHICAGO • CLEVELAND

Can We Deliver Conveyors? YES!



Write, wire or phone, without obligation on your part, for a discussion of your materials handling or product handling problems —or for either of two new illustrated catalogs featuring A-F Scientifically Planned Conveyors and Super-Spray Product Washing Machines for endless stream production.

ALL OUT WAR means "all out production." All out production calls for Alvey-Ferguson endless stream material and products handling systems and A-F super-spray washing machines for faster washing and handling of the materials that win wars!

Anticipating a greater need for conveying equipment, we started a big expansion program months ago. The first unit has been completed and has already resulted in a 25% increase in our production capacity.

New demands have just been made upon America's production. No one knows what tomorrow's demands will be. If your order for a conveyor system bears a Priority number we can and will deliver. All orders, whether for War Production or not, will be given the courteous consideration that has created friends for us throughout America. The Alvey-Ferguson Co., 121 Disney Street, Cincinnati, Ohio.

CONVEYING A-F MACHINERY

ALVEY-FERGUSON
PRODUCT WASHING MACHINES
AND Conveyors

a sure, positive action with practically no slippage, it is claimed. The Squeegee operating principle consists of a rotating drive shaft, keyed to an "off-center" rotor, which itself is keyed to an adjustable eccentric, the adjustments providing adequate take-up for wear on the tube. Shaft and both rotors turn as a unit inside the compressor ring, thus pushing the ring out radially against the tube. This action continues progressively along the curved portion of the tube, producing a rocking squeegee action from suction to discharge side. Compression of the tube advances the liquid or gas, while expansion of the tube, back to its normal diameter, produces a high vacuum which inhales more liquid, which will be exhaled in the following cycle of the "breathing-pumping" action. Huber Pump Division, Downingtown, Pa.

Respirator

Respirator, known as the M.S.D., for protection against inhalation of pneumoconiosis-producing and nuisance dusts is said to be compact, light, easy to breathe through, comfortable to wear, and easy to clean and maintain.

A scientifically designed cartridge, measuring only $2\frac{7}{8}$ by $1\frac{1}{2}$ inches and weighing 1 ounce, provides more than 41 square inches of breathing and filtering area. Multivane construction allows every inch of this filter to be used. No air restriction to cause difficulty in breathing, plus increased filtering efficiency. Easily cleaned by blowing accumulated dust from vanes with an air dusting gun or nozzle.

Designed to fit closely and without leakage the contour of practically any face. De Vilbiss Co., Toledo, Ohio.

Indicating Lamp

For general indicating or signal purposes on switchboards, control desks, and panel boards, indicating lamp known as the Minalite has a rectangular-shaped lens designed for extreme angular visibility. Receptacle is made of one-piece molded material and is suitable for mounting on panels 1/16 to 2 inches thick. Resistors, as part of the unit, are used for line voltage ratings between 50 and 250 volts.

Pressure-type leaf-spring contacts estab-

THIS GADGET HELPS MAKE FLUORESCENT LIGHTING PERFECT—*FOR YOU!*

by HYGRADE

(A pioneer and leader in fluorescent)

IT'S CALLED A

"MIRASTAT"...

ITS INVENTION WAS MOTHERED BY A QUALITY NECESSITY

To give users of Hygrade Fluorescent equipment the proper, prompt kind of starting . . . long lamp life protection and performance . . . Hygrade engineers originated and patented a new and advanced type of starter to meet our high standards.

To list all the inventions . . . developments . . . betterments . . . contributed by HYGRADE to the progress of fluorescent lighting would fill this page.

But you can get the story—quicker and better—in any plant or factory where HYGRADE installations are today producing *more light and better light* from each watt of current.

And there are hundreds of plants right now cashing in on it—in better production, safety records, morale . . . yes, and earnings.

On this basis we offer HYGRADE fluorescent lighting equipment . . . engineered and built completely by HYGRADE . . . covered by one complete HYGRADE guarantee with 40 years' repute back of it.

Our range is wide enough to provide the equivalent of a *specially engineered installation*—for *any* industrial need.

To your advantage is the fact that . . . we're more interested in making the best—than in making the most. We see that as the surest way to maintain our place as a pioneering leader in this field.*

WRITE FOR COSTS . . . RESULTS . . . an eye-opening story in facts and figures. Address Dept. FM-1.

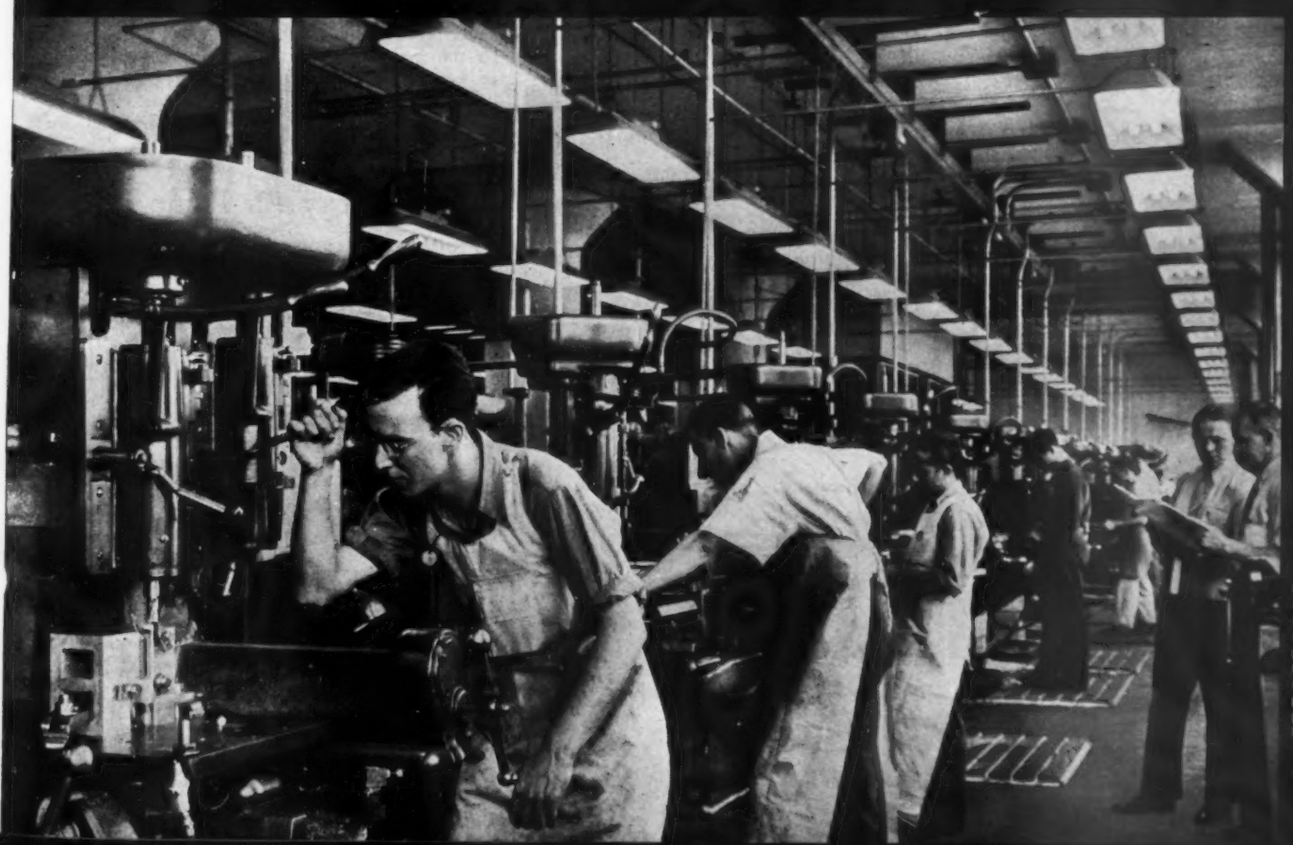
*NEARLY 100 PATENTS PROTECT HYGRADE LIGHTING PRODUCTS! Extraordinary lighting efficiencies are obtained in Hygrade Fluorescent Lamps by tuning the ultra-violet energy to the 2537 Angstrom Units wave length effective in causing the porous film (Hygrade Patent No. 2,096,693) to generate light as shown in Hygrade-controlled Patent No. 2,126,787. Hygrade products are exclusively protected by a large number of other patents, including No. 2,201,817 and No. 1,982,821.

HYGRADE SYLVANIA CORPORATION

Salem, Mass. Est. 1901.

Also makers of Hygrade Incandescent Lamps and Sylvania set-tested Radio Tubes.

HYGRADE—*Everything in Fluorescent at its Finest*



Brilliantly illuminated section of Sperry Gyroscope Company plant, Brooklyn, New York. Here skilled workers produce defense products for Uncle Sam.

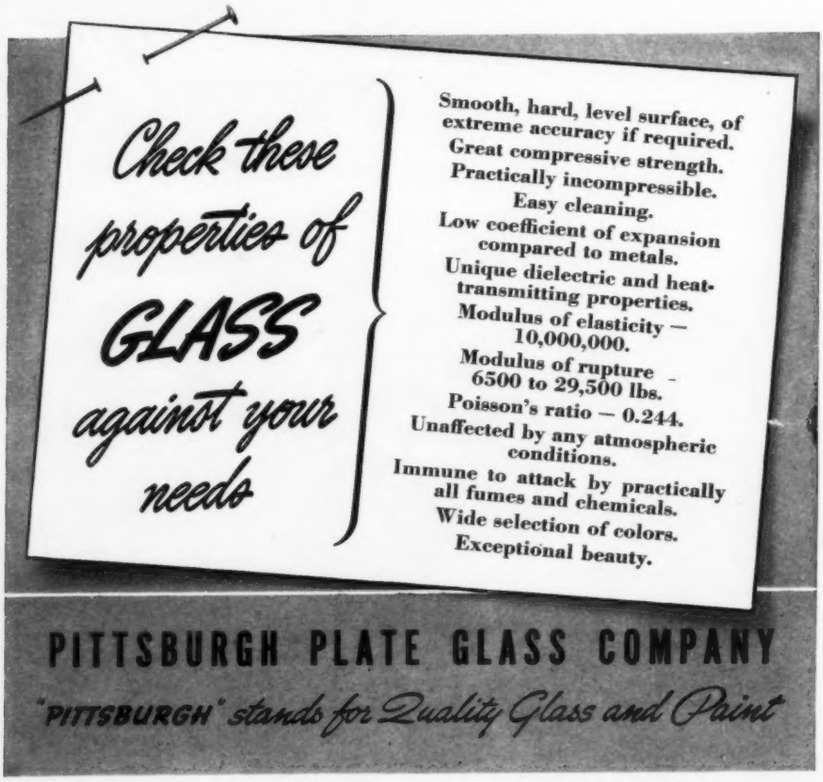
A message to the man who can't get the materials he needs

If shortages of raw materials are squeezing you out, see what the new developments in flat GLASS have to offer!

IF you're having trouble getting metals, plastics or other materials, glass may be just what you need as a practical substitute for them.

Recent developments in flat glass have given it a new strength, a new versatility, a new fitness for many uses never dreamed of before. Today, such products as tempered glass with fused-on colors, structural glass in heavier thicknesses, and other flat glass products in a variety of forms and shapes, have already proved themselves able to do well a lot of jobs formerly done by other materials.

Maybe glass can help *you* lick your shortage problem. It's easy to find out. Submit your problem to our technical development department. Our technical staff will cooperate with your own engineers to see what glass can do for you. There is absolutely no obligation involved. Just write us on your letterhead, addressing Pittsburgh Plate Glass Company, 2008-2 Grant Building, Pittsburgh, Penna.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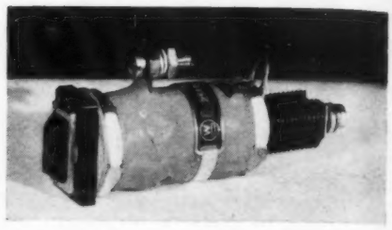
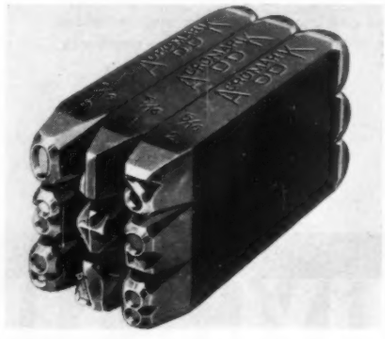
Smooth, hard, level surface, of extreme accuracy if required.
Great compressive strength.
Practically incompressible.
Easy cleaning.
Low coefficient of expansion compared to metals.
Unique dielectric and heat-transmitting properties.
Modulus of elasticity — 10,000,000.
Modulus of rupture — 6500 to 29,500 lbs.
Poisson's ratio — 0.244.
Unaffected by any atmospheric conditions.
Immune to attack by practically all fumes and chemicals.
Wide selection of colors.
Exceptional beauty.
PITTSBURGH PLATE GLASS COMPANY
"PITTSBURGH" stands for Quality Glass and Paint



lish connections with the slide base telephone lamp having a rating of .032–.038 amp., 24 volts. Rectangular lens assembly is held in place by steel spring clips engaging in retaining grooves of the receptacle. Chromium metal holder encases the lens and spring clips. Terminals of standard 10–32 hardware are easily accessible in the rear. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Steel Letters and Figures

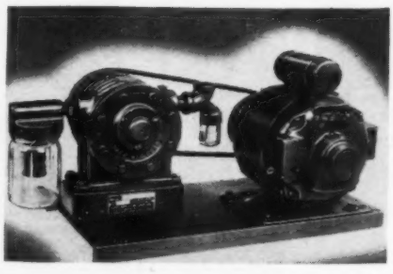
Steels as hard as Brinell 380 Rockwell "C" Scale 40 can be stamped by double-duty steel letters and figures recently developed. Each steel letter and figure is individually engraved and hand-finished for accuracy. The business end of each stamp is tapered to the character so that it is possible to see where the



characters are square on the stamp. Hardened, tempered, and individually tested these stamps enable manufactureres to cold-stamp steels that were formerly stamped hot, thereby eliminating the heating of each part to white heat and suffering possible loss from heat cracks and decarburization. The Acromark Corp., 239-267 N. Broad St., Elizabeth, N. J.

Rotary Air Pump

A V-belt driven rotary air pump, Model 15F50, is especially suited for slow-speed applications. Designed to meet the demand for a V-belt driven pump of good capacity in cubic feet per minute that will provide medium vacuum service. Advantages claimed include slow, quiet opera-



DISSTON announces a plan to conserve defense materials and time

American industry is pushing the accelerator to the floorboard. But full speed ahead is possible only if essential Defense *materials* are used thriftily and more production *time* is saved.

So we have developed the DISSTON CONSERVATION CONTROL PLAN . . . a Plan consisting of three special services:

1. **Instruction cards** for each one of your employees who operates a saw, a file or hack saw or who operates any machine in which Disston products are used. Each card contains practical information on how best to use and take care of a particular tool ...shows how to make that tool work faster, last longer, and produce better results ...with fewer rejects and savings in time and materials.

2. **Bulletin board posters** for use in your plant to educate your employees in the need for taking exceptionally good care of tools and other materials and for saving vital seconds of production time.

3. **Engineering service** in the selection and application of tools in your plant. Disston engineers have the "know-how," based on years of experience in hundreds of industrial plants, to help you conserve materials and time by choosing and using tools correctly ...by fitting the tool to the specific job.

Take advantage of this Disston Conservation Program today! You'll benefit from Disston's background of 102 years' experience in manufacturing and applying quality tools. You can provide valuable free instruction for your employees...increase the efficiency of your plant. Write to Henry Disston & Sons, Inc., 124 Tacony, Philadelphia, Pa., U. S. A.

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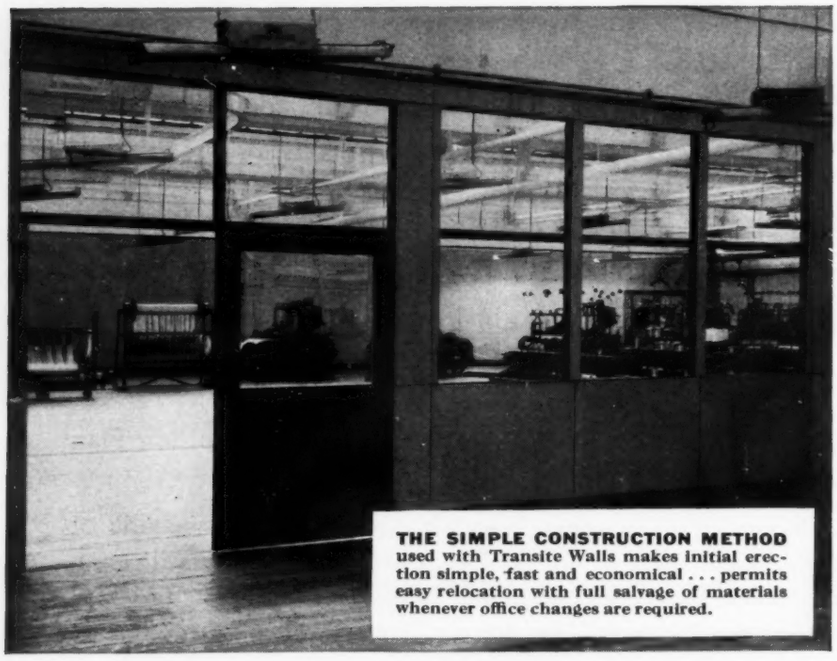


THE SIMPLE CONSTRUCTION METHOD used with Transite Walls makes initial erection simple, fast and economical . . . permits easy relocation with full salvage of materials whenever office changes are required.

When plant offices must be built *FAST*... use J-M TRANSITE WALLS

Easy to install, just as easy to relocate, these asbestos-cement partitions form solid, private offices . . . need little maintenance.

RAPID installation is an outstanding feature of J-M Transite Walls.

Made of asbestos and cement, these modern partitions are supplied in large, light sheets that mean easy, economical handling. A simple construction method cuts installation time far below that required for masonry walls. When alterations are necessary, this same method eliminates dirt and disturbance . . . permits fast relocation of single offices or entire departments. Yet offices are solid and private. And the asbestos-cement composition of Transite Walls provides durability and fire-safety . . . assures continued low maintenance.

• • •

Transite Walls are available in two types, Imperial and Universal. For details on both, send for brochure TR-22A. Address Johns-Manville, 22 East 40th Street, New York, N. Y.

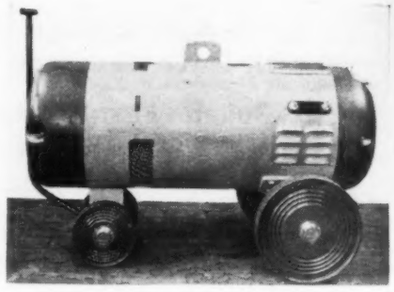
JM Johns-Manville

TRANSITE MOVABLE ASBESTOS WALLS

tion, long life, ease of installation regardless of shaft height or diameter, and low power required in proportion to the large air volume delivered. By changing the size of the motor pulley, this pump is readily adapted for operation with ¼, 1/3, ½, and ¾ hp. motors. A heavy-duty shaft and large antifriction bearings take care of belt side-thrust. Rotary design provides operation without gears, springs, or valves. Gast Manufacturing Corp., Hinkley St., Benton Harbor, Mich.

New Portable Flexarc D-C Welder

For all-purpose welding in industrial plants, and for general maintenance work, a new portable flexarc welder is announced. Inclosure is made of a one-piece weatherproof steel frame mounted on a 4-wheel running gear. Ratings are 200, 300, or 400 amperes for 220, 440, and 550 volt a.c. circuits; 2 and 3 phase, 25, 50, and 60 cycles.



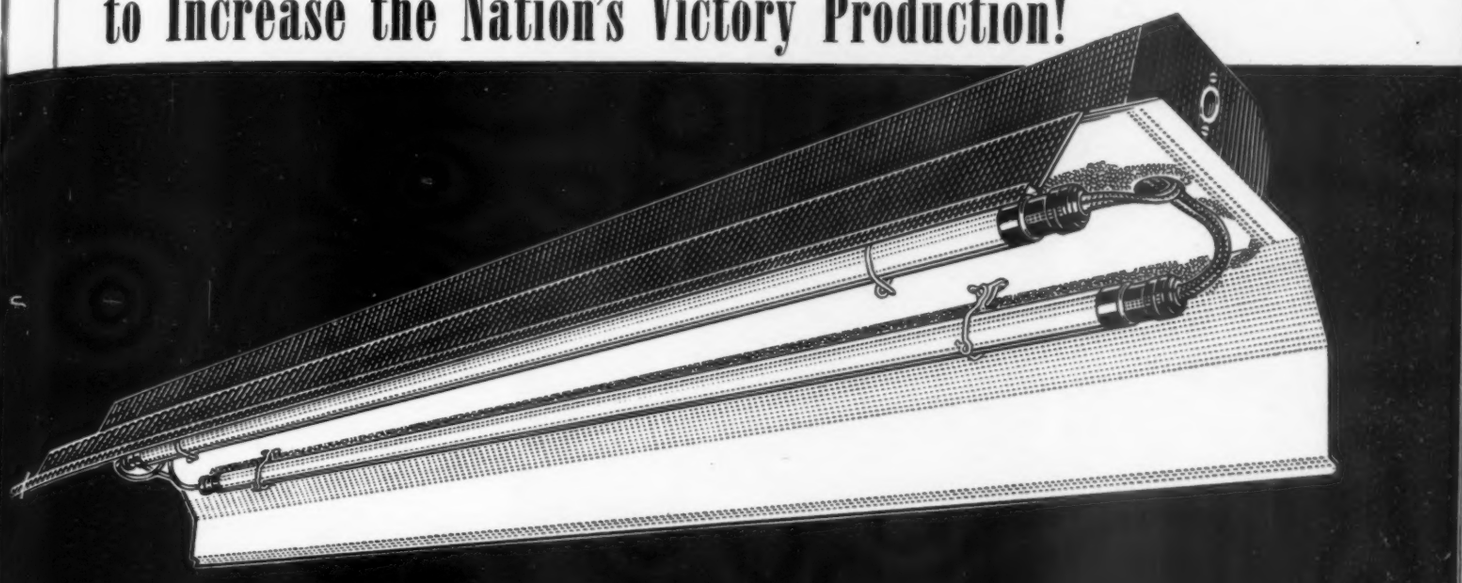
Current adjustment is obtained by a ballcrank, making it possible to preset the desired current before welding. Steady current regardless of arc length is provided by arc control which can be adjusted to suit the welding job.

Driving motors are of the squirrel cage induction type with low starting current, high efficiency and high power factor. Pushbutton-controlled magnetic De-ion starter for the motor provides low voltage protection by removing motor from line if the line voltage is too low. Dual voltage coil on starter makes it possible to change operation from 220 to 440 volts without changing conductor coil. Automatic burnout protection is provided by a bimetal relay mounted on the motor stator windings. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Water Pump Seal

Principal features claimed for bellows-type seal include: (1) Seal has only 2 parts: bellows and spring. Bellows is an exclusive synthetic rubber compound. Grease, oils, salt water, alcohols, and anti-freeze do not affect it. (2) Installed partially compressed; ready for instant seal. (3) Entire unit is spring-driven and operates as a driving coupling. (4) Because of the seal's ability to flex and compress as a unit, pressure variation, misalignment, fan thrust, torque, or vibration set up by an unbalanced impeller are automatically accommodated or compensated for. (5) The serrated contact facings responsible for the positive seal at washer and driving base

It's READY NOW! Improved Fluorescent Lighting to Increase the Nation's Victory Production!



BENJAMIN'S NEW TYPE "RF" FLUORESCENT LIGHTING UNITS give these four outstanding operating advantages:

MORE LIGHT FOR POWER CONSUMED . . .
NEW SOLUTION TO THE FLICKER PROBLEM . . .
QUICKER, SURER STARTING WITHOUT SWITCHES . . .
REDUCED INSTALLATION AND MAINTENANCE COSTS!

Even more satisfactory fluorescent lighting is now possible because of the development of the new "RF" (rectified fluorescent) lamp and the new "RF" Lighting Unit which Benjamin has engineered to take maximum advantage of this new lamp's many superiorities.

IMPROVED LIGHTING EFFICIENCY

With the new Benjamin "RF" Units, it is now possible to secure with greater economy* the higher illumination levels required by National Defense production. The full wave, rectifier type circuit employed in these units, so effectively minimizes flicker and stroboscopic effect at the source without the need for special balancing devices in the circuit, that now even single lamp units can be employed satisfactorily in many installations.

LOWER INSTALLATION COSTS

Greater freedom from operating failure is assured by the elimination of separate starters! Lower cost installation is made possible by certain Benjamin constructional features and the fact that, in many cases, the present wiring will prove adequate.

INCREASES SCOPE OF FLUORESCENT LIGHTING

Because of the high lighting efficiency of the "RF" Lamp, the design and high (79%) reflection factor of the Benjamin type "RF" Unit, it is now practical to use fluorescent lighting in locations where high mounting and wide spacing is required.

FULLY WARRANTED

Benjamin "RF" Units conform to the highest standards of performance, efficiency and durability. They carry the Label of Underwriters' Laboratories, and the Benjamin Warranty. The reflector section is built of heavy gauge, easily cleaned, Benjamin lifetime porcelain enamel steel . . . with that extra safety factor of strength and durability so essential to industrial requirements.

WRITE FOR SPECIAL BULLETIN

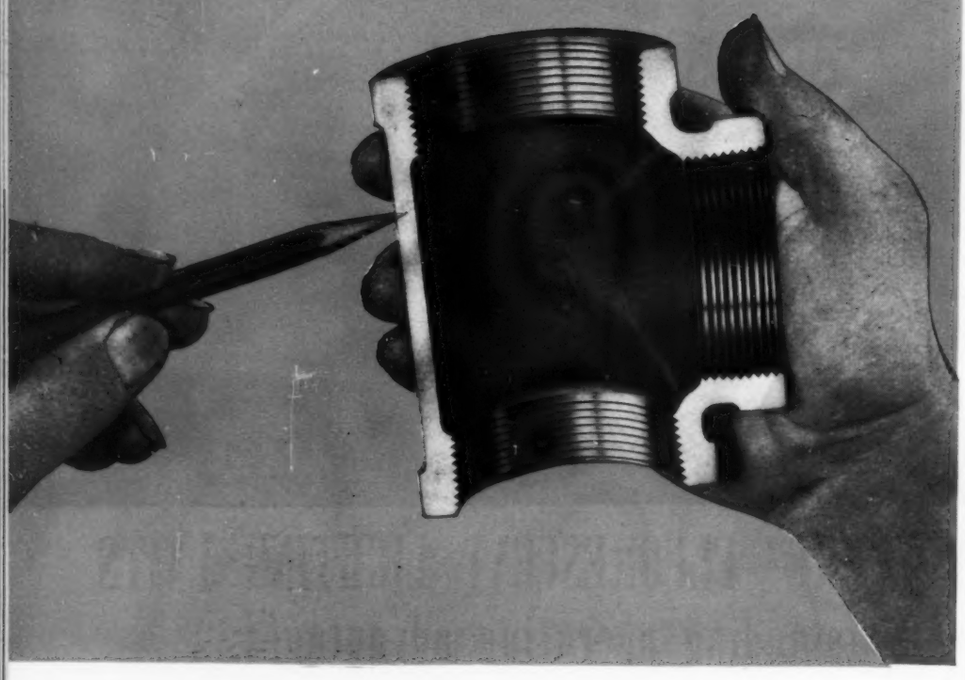
Just off the press is the Benjamin Bulletin on Type "RF" Equipment. Plants engaged in Defense Production should write for this bulletin immediately so that they may make plans now to utilize this equipment at the earliest possible time. Address Benjamin Electric Mfg. Co., Dept. N, Des Plaines, Illinois.

*Twin lamp units on 10x10 ft. spacings provide 35 to 40 footcandles of general illumination (under favorable room conditions) with a total power consumption of approximately 200 watts.

BENJAMIN TRADE MARK

World Leader in Industrial
LIGHTING EQUIPMENT
DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

Finer-Grained Metal



makes these AIR-FURNACE MALLEABLE FITTINGS 20% STRONGER

Less breakage during installation . . . extra safety in service . . . lasting protection against maintenance troubles . . . that's what you can expect from Grinnell Malleable Fittings, made exclusively from Air-Furnace metal.

A bonus of 20% in strength and uniformity is what you get when you insist on Grinnell Air-Furnace Malleable Fittings. They are available everywhere through wholesalers, heating and plumbing contractors and branch offices in all principal cities. Catalog "Grinnell Pipe Fittings" shows the complete line. Write for one. Grinnell Co., Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

OTHER PLUS FEATURES OF GRINNELL FITTINGS

- Controlled Annealing
- Tested Strength
- Smooth Cores
- Uniform Wall Thickness
- Precision Threads
- Accurate Chamfer

CAST IRON
AIR-FURNACE MALLEABLE IRON
STEEL . . . BRONZE
PIPE FITTINGS
By

GRINNELL

WHENEVER PIPING IS INVOLVED

points are formed in a series of concentric grooves and flat-faced ribs, effecting seal with a suction-action. (6) Seal cannot be installed wrong. Both ends are identical—either end is right. Crane Packing Co., 1800 Cuyler Ave., Chicago.

Compressor

Model #50 Compressor is a small, compact unit including mechanical intake valve, long life discharge valves, and multi-

cylinder construction. Has four cylinder "V" type construction that does not require cooling unit or running water.

Built in many different mountings, either V-belt or direct-motor drive, on air receiver base or overhead tank, suitable for pressures up to 200 lb., and can be operated at full speeds or reduced speeds, for minimum or maximum loads. Suitable for drilling, spraying, riveting, chiseling, chipping, stone carving, sandblasting, inflating tires, and numerous other operations where compressed air is needed. Being lightweight and compact, and with no vibration, platforms, supports, or foundations are not needed. Schramm, Inc., West Chester, Pa.

Two-Lamp Industrial Fluorescent Unit

V-type two-lamp industrial units with porcelain enamel reflectors, using the basic Wiremold #3,000 channel and fittings, provide flexibility in installation either as single or multiple 2-lamp units, make

A BREAKDOWN

is all right in its place, but not in your place. You can't afford, in these times, to take risks. Avoid interruptions of production and loss of output and money by using

SHAWMUT

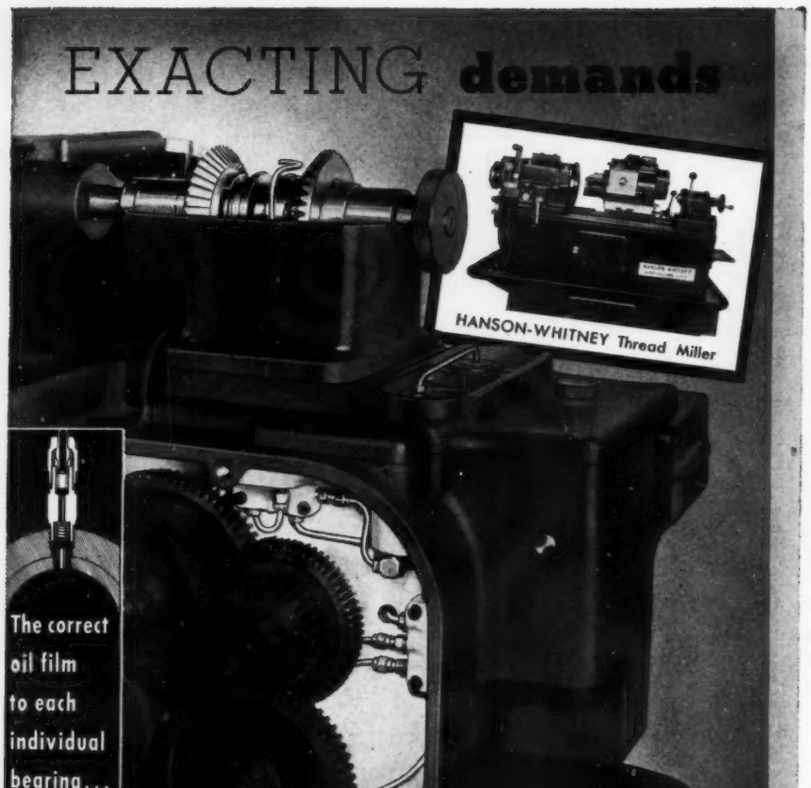
SHUR-LAG

RENEWABLE FUSES

A dozen or more outstanding features place them far ahead of all other time-lag fuses in economy, safety, and convenience. Ask your dealer about SHUR-LAG fuses today, or write for our Bulletin 400.

THE CHASE-SHAWMUT COMPANY
NEWBURYPORT, MASSACHUSETTS

FUSE MAKERS SINCE 1893



• Production machines developed for highest quality of performance — unfailing precision . . . greater refinement and closer limits in product . . . versatility, speed, quick set-up — naturally take advantage of Bijur automatic, metered lubrication. And the user reaps the benefit of economy as well as quality and quantity in production. Safeguarded machine accuracy — with spoilage and costly maintenance eliminated!

BIJUR LUBRICATING CORPORATION • LONG ISLAND CITY, N. Y.

1486

BIJUR

AUTOMATICALLY Correct LUBRICATION

MEMO

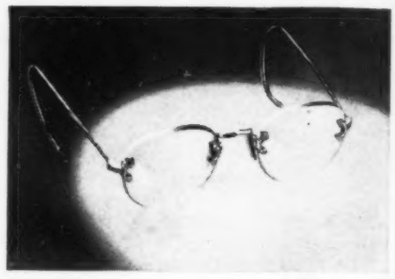
CHECK THOSE NEW MACHINE SPECIFICATIONS. THE BEST MAKES HAVE AUTOMATIC LUBRICATION.

1558

continuous runs of double Line-O-Lamps possible with any desired number of lamps. Available for 20 or 40 watt fluorescent lamps. Hangers and fittings are available for installations against ceiling surfaces with canopies and adapters to cover the existing ceiling outlets, or for hanging at required levels below ceiling. The Wiremold Co., Hartford, Connecticut.

Safety Spectacles

Rimless safety spectacle known as the "Supervisor" is fitted with Tulca Safety lenses (not glass). Designed specifically for use by supervisors, checkers, inspectors, maintenance men, and visitors, who may be exposed to eye hazards in plants even

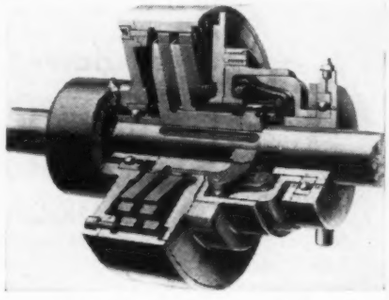


though they are not actively engaged in operations where the wearing of goggles is mandatory.

One of the most important safety features of these Tulca Lenses is the fact that they do not pit, the manufacturer states. Available with or without side shields. The Tulca Division of the Univis Lens Company, Dayton, Ohio.

Friction Clutch

Available in single and multiple disk types and in a wide range of sizes, Torque-Master friction clutch is designed for the heaviest type of work, impact, and pulsating loads. All parts totally inclosed. Friction plates are of gear-tooth design, while the entire

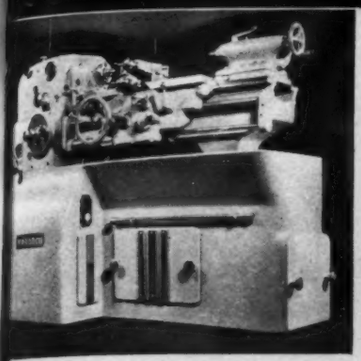


operating mechanism consists of only a few moving parts. All adjustment for wear or load conditions is made with one knurled hand adjusting ring. T. B. Wood's Sons Co., Chambersburg, Pa.

Wood Roller Conveyor

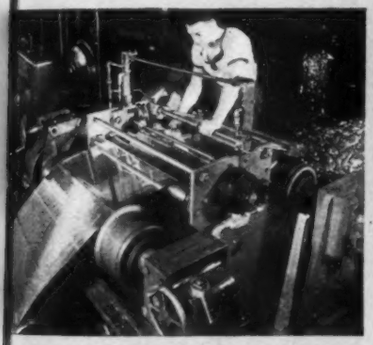
Wood roller conveyor especially designed for handling explosives. Roller and frames are made of maple and brass. Bearings are either antifriction bearing or oilless bronze. Shafts and shaft holders are made of brass. Supports are made of wood and

Still More Answers to WHO IS DOING WHAT *with*

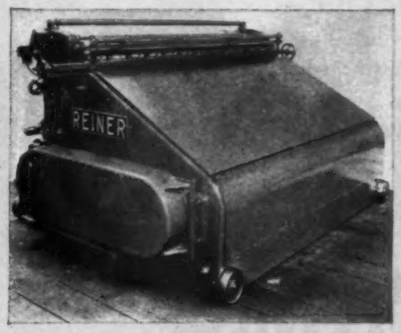


TOOL ROOM LATHE—A machine-tool maker designed a new 10-inch all-electric precision lathe with all elements of the Reliance V★S Drive built in as integral parts of the machine. Provides a smooth range of spindle speeds from 5 to 2500 r.p.m. indicated by a magnetic type tachometer on front of lathe headstock.

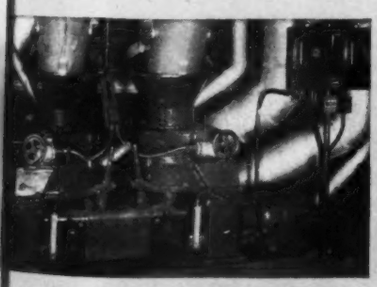
HOSIERY MACHINE—The Reliance V★S Drive for this full-fashioned hosiery machine is arranged for "program" control. Separate speed control handles are set to suit five different operations; speeds change automatically as each operation is finished.



FOIL WINDER—A producer of aluminum foil gets smooth acceleration from a low threading speed to the top operating speed with a 5 hp. 148-1150 r. p. m. Reliance V★S Drive. Fewer breaks when winding mean more production.



BEAMING MACHINE—A textile machinery builder made use of the V★S Drive to design a beamer on an entirely new principle. All elements of the Drive are enclosed within the machine. Provides stepless speed range from 50 to 1000 yards a minute; slow starting speeds; quick stopping.



STOKERS—V★S Drives are readily combined with instruments regulating temperatures and pressures so that speeds change automatically. The drives on these coal feeders change their pace as required to keep steam pressure constant.

BODY-CHASSIS ASSEMBLY—An automobile plant synchronizes the travel of body and chassis assembly lines by using Reliance V★S Drives. An operator, seated where the lines join, speeds up or slows down the overhead body conveyor so that the body can be dropped into place on the chassis.

AN ALL-ELECTRIC ADJUSTABLE-SPEED DRIVE for A-C. CIRCUITS

RELIANCE V★S DRIVE

Speed Ranges up to 16 to 1
Sizes — 1 to 30 hp.

1 SPEED CONTROL CONVENIENCE WITHOUT LIMITATIONS. Place speed-changer and start-stop button at any convenient point to which a wire can be run. Control is within easy reach.

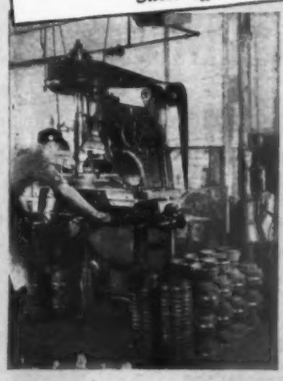
2 DIRECT DRIVE. Lower cost, because fewer parts (no intermediate speed-changing device). Power is closer to where it is needed. Use less space. Streamline your machine design.

3 FROM A-C. POWER SUPPLY. The "packaged" V★S Speed Control Unit brings you important advantages at a new low price. Mount it anywhere. Simply connect it by three wires to a 3-phase a-c. circuit.

Other Production Aids: Quick stopping, reversing, speed-setting, safe speeds for threading, ample starting torque with smooth acceleration.

Get Bulletin 310 for details

RELIANCE ELECTRIC & ENGINEERING CO.
1082 IVANHOE ROAD • • CLEVELAND, OHIO
Sales Offices in Principal Cities



MILLING MACHINE—A machinery builder put new life into an old milling machine by applying a 7½ hp. V★S Drive. With more power, a wider range of milling speeds and more convenient control the machine has become a bigger producer.

CABLE FORMING and WRAPPING—A V★S Drive replaced the system of gears and pinions formerly used to obtain speed changes for the taping head on this cable-forming and wrapping machine. Now, no time is lost in changing speeds. Product is more uniform.

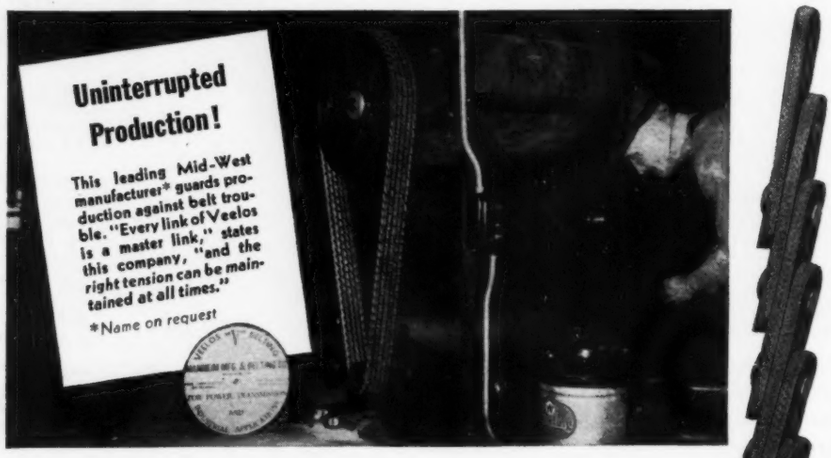
RELIANCE ELECTRIC & ENGINEERING CO. • 1088 Ivanhoe Road, Cleveland, Ohio

BIRMINGHAM • BOSTON • BUFFALO • CHICAGO • CINCINNATI • DETROIT • GREENVILLE, S. C. • HOUSTON, TEX. • LOS ANGELES • MINNEAPOLIS
NEW YORK • PHILADELPHIA • PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • SAN FRANCISCO • SYRACUSE, N.Y. • AND OTHER PRINCIPAL CITIES

RELIANCE A-C D-C MOTORS

The *MINUTE MAN* Says:

PROMPT BELT DELIVERY? VEELOS IN ROLLS ARRIVES ON-THE-DOT!


Uninterrupted Production!
This leading Mid-West manufacturer* guards production against belt trouble. "Every link of Veelos is a master link," states this company, "and the right tension can be maintained at all times."
*Name on request

THE "minute men" of industry — engineers and shop men who must save every possible minute of production time—are turning to the 60-second V-Belt—Veelos in rolls. Installation is a matter of minutes . . . adjustment is fast and easy. Veelos *in rolls* provides an automatic supply of matched V-Belts of any length . . . speeds production right down the line! And—right now—*Veelos deliveries are on-the-dot.*

JOIN THE MINUTE MEN!

Why not save valuable production time yourself? Let a Veelos sales engineer—especially trained in power transmission work—tell you how Veelos in rolls can boost your production without any increase in horsepower or manpower.

MANHEIM MANUFACTURING & BELTING CO., MANHEIM, PA.

VEELOS V-BELT
ADJUSTABLE to any length
ADAPTABLE to any drive

✓ CHECK!

Ask your distributor how slippage and stretch are ended by the more powerful grip and greater resilience of OCTOPUS FLAT TRANSMISSION BELTING.

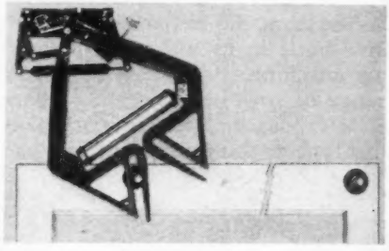
✓✓ DOUBLE CHECK!

And ask him about KEYSTONE CANVAS STITCHED BELTING for conveyor or elevator use. Your order can be delivered in a week or less!

are adjustable for various heights. Construction throughout is wood and brass to prevent any sparks from friction. Standard Conveyor Co., North St. Paul, Minn.

Door Operator

Called the Inertia Model, Air-Lec door operator for sliding doors is designed upon a different principle. Application of force is more direct. Action is started by compressed air from the cylinder. During the



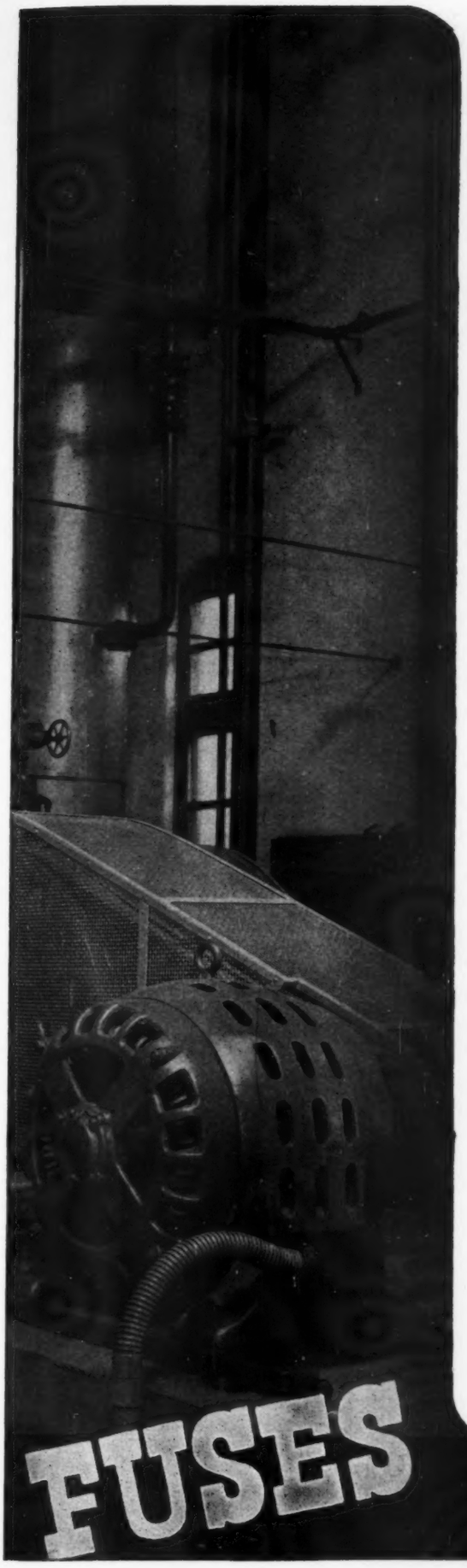
main part of travel the door is rolling freely by its own momentum, at a controllable, pre-determined speed and free from the operator. Main spring, regulated by checking action of air cylinder, does last part of opening or closing door. Result is a quick start and a smooth stop, with less air used. Schoelkopf Manufacturing Co., Madison, Wis.

Actuator Bracket

Micro switch actuator, Type "M," in the form of a bracket designed for panel mounting fits many applications because of the sturdiness of the assembly, the protection it gives the micro switch unit, the ease with which the switch unit can be replaced without removing the actuator from its panel mounting, and the fact that the location of the point of operation of the switch can be changed through adjusting the panel mounting.

Three hex nuts used on the panel mounting bushing provide the mounting means. Two nuts are used to position the switch on the panel or strut on which it is mounted, and the third nut locks the assembly in place. Actuator can be mounted in holes 15/32 in. in diameter on panels up to 1⅛ in. thick.

Different lengths of plungers are available. Type M-2 allows for ¼-in. overtravel and has a short bushing; Type M-7 allows ⅞-in. overtravel and has a long bushing; Type M-27 is a hybrid having ¼ in. overtravel and a long bushing. Micro Switch Corp., Freeport, Ill.



When Inexpensive Buss Fuses Give "Non-Shutdown" Protection, Why Bother With Costly Protective Devices That Are Not As Efficient?

Why spend extra money for costly mechanically operated devices—when you can get inexpensive fuses that hold circuits in operation for years without opening once?

Why be annoyed by useless shutdowns with ordinary fuses when BUSS construction reduces needless opening of fuses to a minimum?

The experience cited by Mr. Knight simply proves once more that it is not necessary to suffer from useless shutdowns caused by needless opening of protective devices. It shows that once properly installed BUSS fuses can be forgotten.

They require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens it requires less than 45 seconds to renew it with an inexpensive link.

The experiences of thousands of plants throughout all industry have proven time and again that with BUSS Super-Lag fuses you can obtain trouble free protection at a lower overall cost than with ordinary fuses or mechanically operated devices.

Here Is Why BUSS Fuses Greatly Reduce or Entirely Prevent Needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus, excessive heat which causes fuses to blow when they should not is prevented.

The fuse link used is the famous "BUSS SUPER-LAG." It has lag-plates attached to it. These give it a long time-lag so that unusually heavy starting currents or other harmless overloads will not cause the fuse to blow.

—And Here Is How To Solve The "Shutdown Problem" In Your Own Plant

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble proof protection that BUSS Super-Lag fuses give.

BUSSMANN MFG. CO., University at Jefferson, St. Louis, Mo.
Division McGraw Electric Company

WHY BUSS FUSES
DON'T BLOW NEEDLESSLY
10 FEATURES in the design of the FUSE-CASE help make it possible.
The SUPER-LAG development in the FUSE-LINK completes the job.

FOR WANT OF A DROP.....
For want of a drop of oil at the right time and place many new machines have been seriously damaged during initial run-in following assembly . . . To avoid this waste, more and more manufacturers depend upon "dag" colloidal graphite . . . Send for Technical Bulletin No. 112V and name of local supplier.
ACHESON COLLOIDS CORPORATION
PORT HURON, MICH.
"dag" is a registered trade-mark of Acheson Colloids Corporation.
dag
MAKERS OF COLLOIDAL PRODUCTS

Here are a few of the many uses of colloidal graphite in industry—check any with which you may be having lubrication difficulties.

"DAG" COLLOIDAL GRAPHITE FOR:

CONVEYORS..... ☐	SCREW THREADS..... ☐
FORGING DIES..... ☐	STEAM CYLINDER..... ☐
COMPRESSORS..... ☐	CASTING..... ☐
GLASS MOLD..... ☐	CONDUCTIVE COATINGS.... ☐
ASSEMBLY AND RUN-IN.... ☐	IMPREGNATION..... ☐

Tear off this coupon and attach to your letterhead—it will bring a working sample for the uses you specify.

ACHESON COLLOIDS CORPORATION • Port Huron, Michigan

Salvaging Scarce Metals

(Continued from page 71)

added to others already there, with confusing results such as "Mild Nickel." Because of this, we plan to shift over soon to a system of tacked-on tags, which will be torn off when they no longer apply.

Before the reclamation department sends the turnings into the baler, they are spot checked for analysis by the man in charge there. He is an operator, not a chemist. But the metallurgical department has equipped him with a couple of bottles of reagents and taught him the simple tests achieved by dropping the reagents on the metal and looking for color on a white paper beneath. Thus we double-check against mixing materials. Incidentally, we are right now on the point of changing our method of compressing this scrap. Instead of baling here, we shall shift over to briquetting, just as soon as new equipment is installed . Thus we expect to get more compact material, more easily handled in charging the cupolas. At present, we have briquetting equipment only sufficient to handle our grey iron borings, approximately 33 tons a day.

But chips, turnings, and borings are only part of the problem of segregating scrap materials and using them to the best advantage. There is also the percentage of rejected and spoiled work in process that necessarily occurs in any precision metal-working plant. Unfortunately, we have our share of this type of scrap. We must accordingly handle it effectively.

The reclamation department has a yard where it stores those scrap materials. The scrap is segregated by analysis in bins. Some parts, which produce substantial volumes of this scrap and have particularly desirable contents of alloying metals, are kept entirely separate. For example, cylinder liners. These liners are made of a particular nickel-iron alloy, and, because they are castings which must be flawless and machined to exacting limits; a reasonable percentage of them becomes scrap. These parts, therefore, are stored in a separate bin, accumulated, and shipped to the foundry on days when it is pouring nickel-iron. Similarly, we accumulate rejected shafts and other nickel-steel forgings, and send them to the foundry along with nickel-steel scrap from our own machine shop, including plate and bar stock scrap.

Here, too, heavy melting steel is reduced to foundry size. What can be

TECHNICAL LIBRARY OF KOPPERS

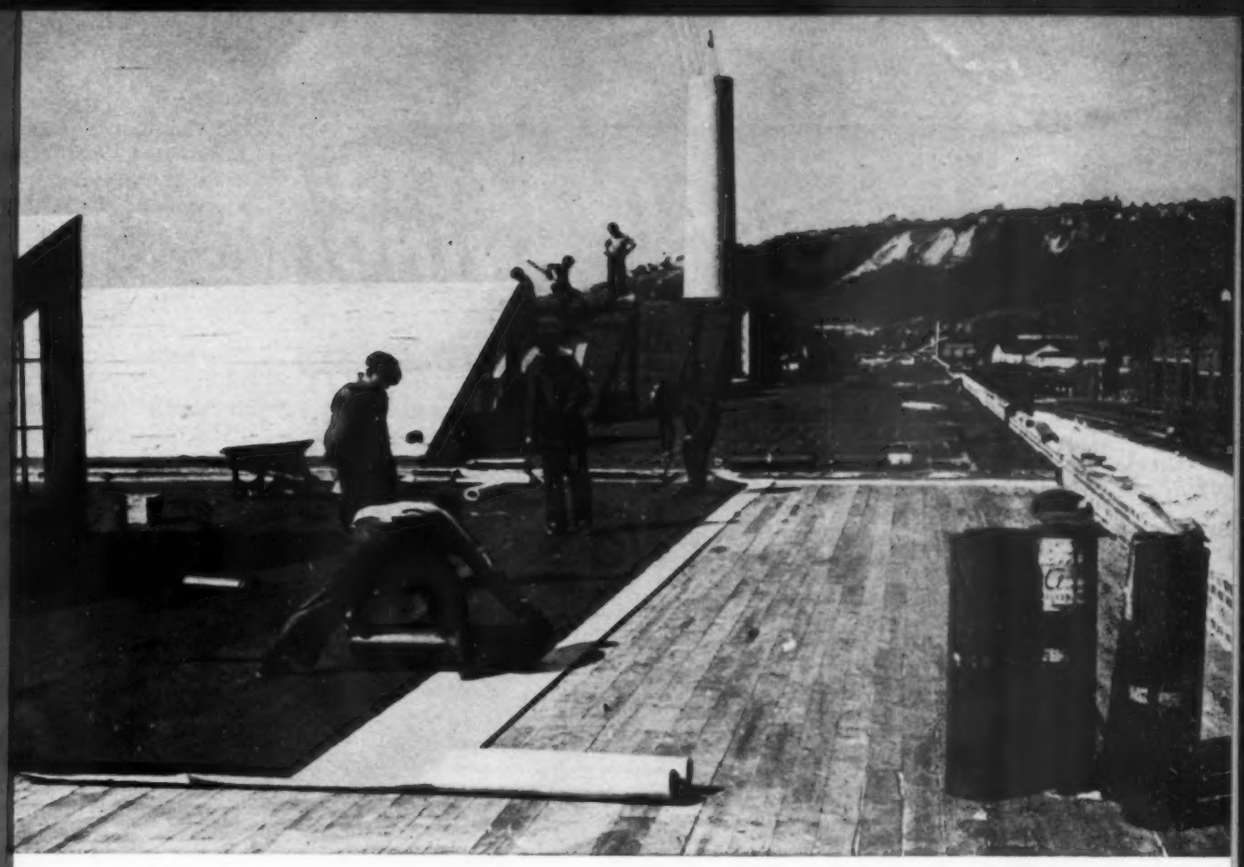
How to Build a "No-Headache" Roof

How To Prevent Water Damage To Building Foundations

How Pressure-treated Timber Can Solve Many Priorities Problems

How To Avoid Trouble on Power Shaft Connections

How To Buy Coals for Greater Efficiency



This is a "No-headache" roof

You may have had some experience with a "headache" roof.

If you have had that sad experience, you will find assurance in the many old records of 20 years, 30 years or even 40 years of trouble-free service that have been given by roofs of coal tar pitch.

Coal tar pitch lasts because it can resist water. It lasts because it has the power to heal small breaks and present an unbroken surface to the elements. Coal tar pitch roofs last because their slag or gravel surface protects them from sun, hail and wind.

For your own sake, stick to coal tar pitch.

KOPPERS COMPANY
PITTSBURGH, PA.

KOPPERS COAL TAR PITCH ROOFING AND WATERPROOFING

use KOPPERS *products*

Fill out and mail

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Please send me copies of these folders:

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- ☐ "Roofing Specifications"
- ☐ "Water-Cooled Roofs"
- ☐ "Steep Roofs of Coal Tar Pitch"
- ☐ "Membrane Waterproofing Specifications"
- ☐ "Dampproofing"
- ☐ "Where to Use Pressure-treated Timber"
- ☐ "Coals for Stokers
- ☐ "Fast's Self-aligning Couplings"
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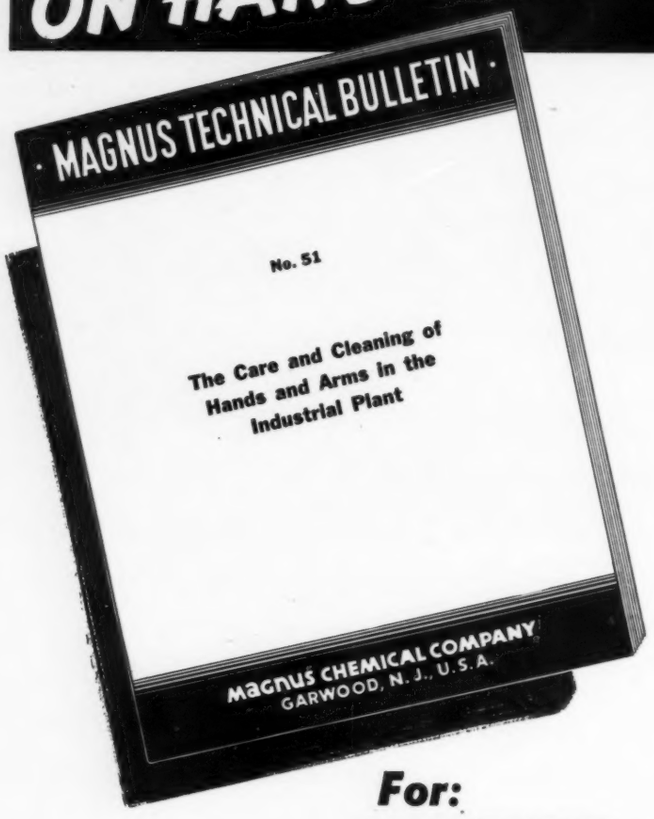
GET THESE PLAIN FACTS ON HAND CLEANING!


MAGNUS TECHNICAL BULLETIN
No. 51
The Care and Cleaning of Hands and Arms in the Industrial Plant
MAGNUS CHEMICAL COMPANY
GARWOOD, N. J., U.S.A.

For:

SUPERINTENDENTS
SAFETY ENGINEERS
INDUSTRIAL PHYSICIANS
INDUSTRIAL INSURANCE MEN

and every plant man who is interested in control of industrial dermatoses. This Magnus Technical Bulletin gives you the plain facts on the care and cleaning of hands and arms in the industrial plant—

- What a hand cleaner should do—and what it should not do.
- SAFE detergents and scouring agents.
- Cleaning routines.
- Protection on-the-job.
- All the basic data on this important phase of plant operation.

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MAGNUS CHEMICAL COMPANY

Manufacturers of Cleaning Materials, Industrial Soaps, Metallic Soaps, Sulfonated Oils, Emulsifying Agents and Metal Working Lubricants

220 South Avenue **Garwood, N. J.**

Magnus CLEANERS

reduced in an alligator shear, gets this treatment. Other types, which because of size or section are unsuitable for shearing, are cut up with torches. In this yard are trainees who are taking the two-year welders' training course offered by our training department. These lads torch down the big, awkward stuff as part of their training. The trainee learns thus, under the eye of his instructor, to cut all types and sections of ferrous material.

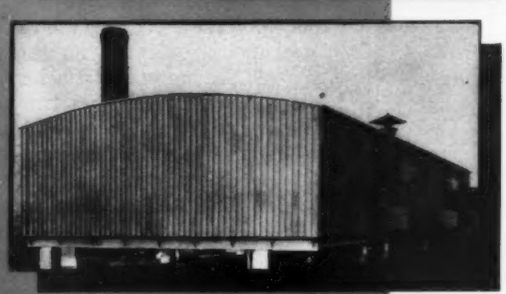
In this yard is done miscellaneous preparation of scrap. What the department calls "hair"—light gage sheet metal trim, baling wire, core wire, steel strapping, nails, rusty drums—is compressed into bales. It all goes to the foundry. Foundry orders come to the reclamation department for a car of this or three cars of that, exactly as they might go to any dealer in waste metals. All told, this traffic between the two departments of our plant averages about two cars a day—and it will be increased by close to a car a day when the changes and extensions now in progress are completed.

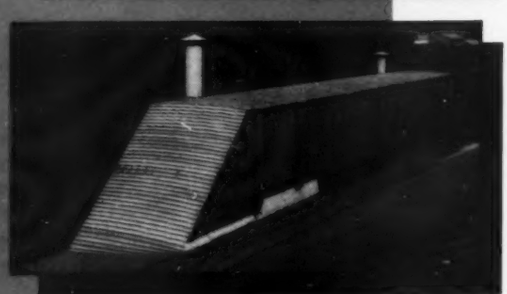
Runs a Test

When the foundry starts up a cupola on nickel-iron, it uses all the miscellaneous types of nickel-content scrap that have been mentioned here. These average 2 percent nickel content. The foundry metallurgist runs a test on each melt at the spout of the cupola, and the amount of nickel-bearing scrap charged is governed by the nickel content desired in the castings being poured. In few instances it may be necessary to raise the nickel content above that which may be obtained by using nickel bearing scrap. However, these instances are rare.

An idea of the importance of this contribution of the reclamation department may be obtained from a few statistics. Gates, sprues, and other home scrap created in the foundry is used by the foundry without ever passing through the reclamation department, and is accordingly omitted from these figures. The nickel-bearing scrap from the other manufacturing departments in an ordinary year will contain about 110,000 pounds of pure metallic nickel, with a value around $38,000. The arithmetic is simple. Figure it for an average year as 230 tons per month of scrap containing 2 percent nickel, worth around 35¢ per pound. If the nickel-bearing scrap were not so scrupulously segregated, it could not be used thus effectively in our own foundry. And if we sold it, as mixed scrap it would bring us no comparable rate of return. From the standpoint of wartime production—which certainly should be a major consideration in the policy of any industry using strategic materials—any handling less careful

MAHON *On-the-Roof* OVENS





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Placing industrial Drying and Baking Ovens out of the way, *on the roof*, was pioneered by Mahon engineers as a practical means of releasing valuable plant space for other production uses. With the addition of so much new Finishing Equipment and the constant rearrangement of plant facilities in today's vastly enlarged production operations, Roof Type Ovens warrant special consideration. This practice of placing ovens on the roof not only economizes by saving greatly needed floor space but eliminates certain restrictions in oven design caused by columns, piping, ducts, etc., so often encountered inside the plant. At your request, Mahon engineers will make a study of your product and production and will demonstrate the advantages of this type of oven installation, if practical for your purpose. A survey incurs no obligation. Write today.

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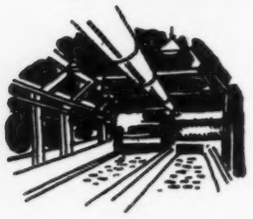

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than that employed by our reclamation department would result in a substantial proportion of this nickel being lost. In 1941-2, with greater activity and even greater scrap tonnage, every effort is being made to lower the nickel requirements in our own castings and other products. Therefore, the amount of reclaimed nickel will undoubtedly be less in proportion.

There are two other major types of conservation practiced by our reclamation department in the field of the scarce alloying metals. One of them has to do with the salvaging of sheet-metal trimmings for the production of smaller parts requiring the same gage and analysis. The other has to do with reconditioning or intelligent scrapping of high-speed tool steels in expendable tools.

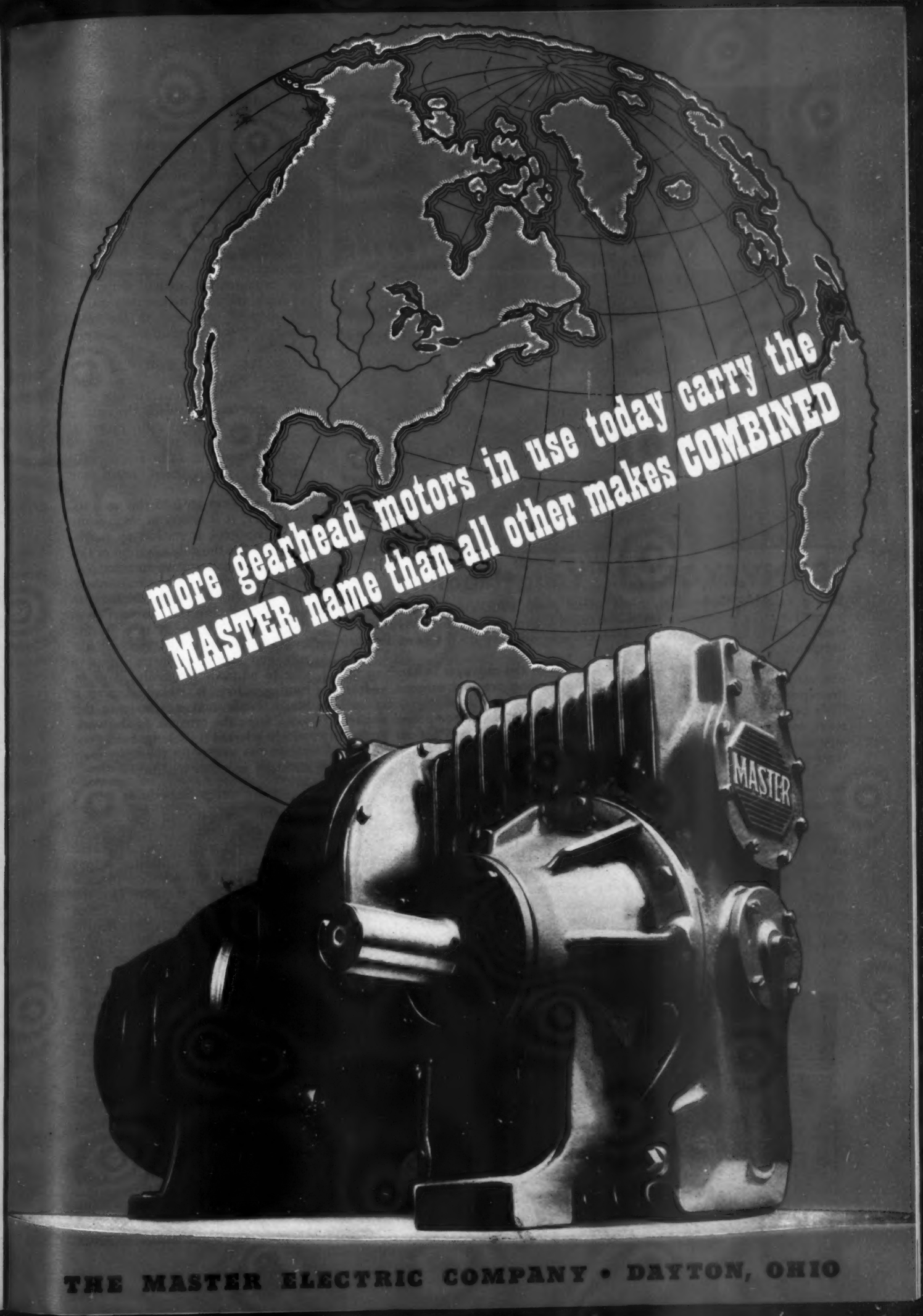
Crop ends and trimmings of sizes and formulas adapted to smaller parts are hauled to a reclamation department stockroom for salvaging. They run all the way from .00-in. shim stock to heavy plate crop ends, and in sizes from some that are pretty substantial to others that are only a few inches either way. It might be explained that our company is rather unusually devoted to making all its own parts, spare parts, and repair parts for its full line of machinery. Consequently, the variety of parts to be made is an effective obstacle to buying sheet metal made to our specific size needs, as is possible in some industries where larger runs and fewer sizes are the rule.

Reclamation operates on the principle that the better job it achieves in seeing that crop ends and trimmings go back into the same type of parts, but smaller, the less the number of sheet sizes the purchasing department will have to specify. As formerly handled, crop ends went into the scrap pile, where today they would be worth about $19.50 per ton.

Small Pieces Re-used

The guiding policy of reclamation in the re-use of small pieces of sheet metal is that efficiency in this direction is in proportion to the cooperation received from the production shop. It is accepted that reclamation cannot cram its odds and ends down a production department's throat, but must make that department actually want to obtain scrap metal whenever it is available.

To serve as a guide to what parts can be made of smaller pieces, the department where reclamation stores this stock has a rack filled with templets of various small parts. Each such templet carries, stamped on it for enduring accuracy and painted on it for ready reference, the salient facts about it: 16-gage, 5/16 x 4 hot rolled, open die, Part No. 2A3417. From these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". . . we selected your type of roller conveyor . . . because we felt that the contour of your steel roller is very favorable to the transportation of shells which have a finish turned copper band on them. The concave roller gives the band a two-point contact and consequently reduces the liability of damage by over 50% over what it would be if the rollers were straight or just slightly concave."—report from large armament plant where Standard Conveyors are used for fast, safe "line" production of 3 inch A.A. shell.

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facts, it is possible to determine quickly and accurately whether a given shape and class of scrap can be used. The unvarying rule is that scrap can be used in a production department only if the parts can be turned out as economically as if new stock were being used. Otherwise it would be no go. Reclamation must not increase production costs.

As soon as crop ends and trimmings are received in this department, they are trimmed to usable shape—for example, the long, narrow strip may be trimmed off and sent to the baler, leaving a piece square on two sides and rounded otherwise, big enough for several parts that are made of the same gage and analysis of steel. The analysis is coded on the material, in our plant color code and also with the catalog specification number for the particular alloy. These facts are usually applied on the side of a stack, by an employee equipped with a paint brush and bucket.

When pieces go into this reclamation stock, it is always in some quantity. The stock is stacked up neatly, since order is the only salvation of this place, as the alternative to utter confusion. Originally, the effort was to keep pieces of the same thickness in the same area, but this was soon given up. It kept too much space vacant awaiting the right thickness of materials, and also it permitted errors in gage to be made too easily. Now incoming material is stacked wherever it fits in nicely, and everybody in this room, from the foreman to the workmen, is selected because he has a good memory as well as for the other more obviously necessary qualities.

Advance Schedules

Reclamation receives the advance production schedules that are issued to all production department. These schedules break down planned output by models into the numbers of each part that will be required in each month. Therefore, when a new lot of scrap sheet metal comes into department, the man in charge looks it over, and then undertakes to match it up with some one of the rack of templets showing the same thickness and analysis. He determines that he has enough, let us say, for 2,000 pieces of the 3,000 that will be required next month. So he goes to the rough stores department, from which the stock would normally be requisitioned, and writes on its production sheet opposite the particular item, "Material for 2,000 available in reclamation." Also he notifies production planning to order it from reclamation. Then he goes back and labels the pile, "Hold for Part 3A492." In the normal course of events, the stock is requi-

This FA Busduct installation in a Michigan defense project shows how simple it is to place the machines, to plug in, and to start operation without delay.

Save Production Hours when moving machines

With FA Busduct for the distribution of power, it's a simple matter to "move the machine — plug in — go!" The easily accessible outlets of Plug-in FA Busduct, conveniently spaced, make it possible to move the machines to any desired location — to plug in quickly — and to resume operations with a minimum loss of productive time.

This is the Modern Way!

Compact and flexible, it is the convenient method for distribution of Electric Service . . . It is ideal when changes are necessary in machine layout. And it is economical from every standpoint, as installations in numerous plants have proved.

FA Busduct—both feeder and plugin types—are made in standard 10-foot sections. Each standard section of the Plugin type is arranged with nine plug-in outlets on 12-inch centers. (Other spacing optional.) Suitable elbows, tees, cross-connections, expansion joints, transposition joints, end boxes, intermediate feed-in and feed-out boxes and reducing capacity sections, are supplied to fit required space or position — whether on wall or ceiling.

The copper busbars are contained in enclosures of steel or aluminum. They are rigidly supported at proper intervals by specially designed insulators that insure correct spacing — to meet the requirements of the National Electrical Code. Contact surfaces of connecting bars are silver-plated, to insure low resistance joints. This is further assured by specially engineered spring pressure bolts which hold the joints under even compression.

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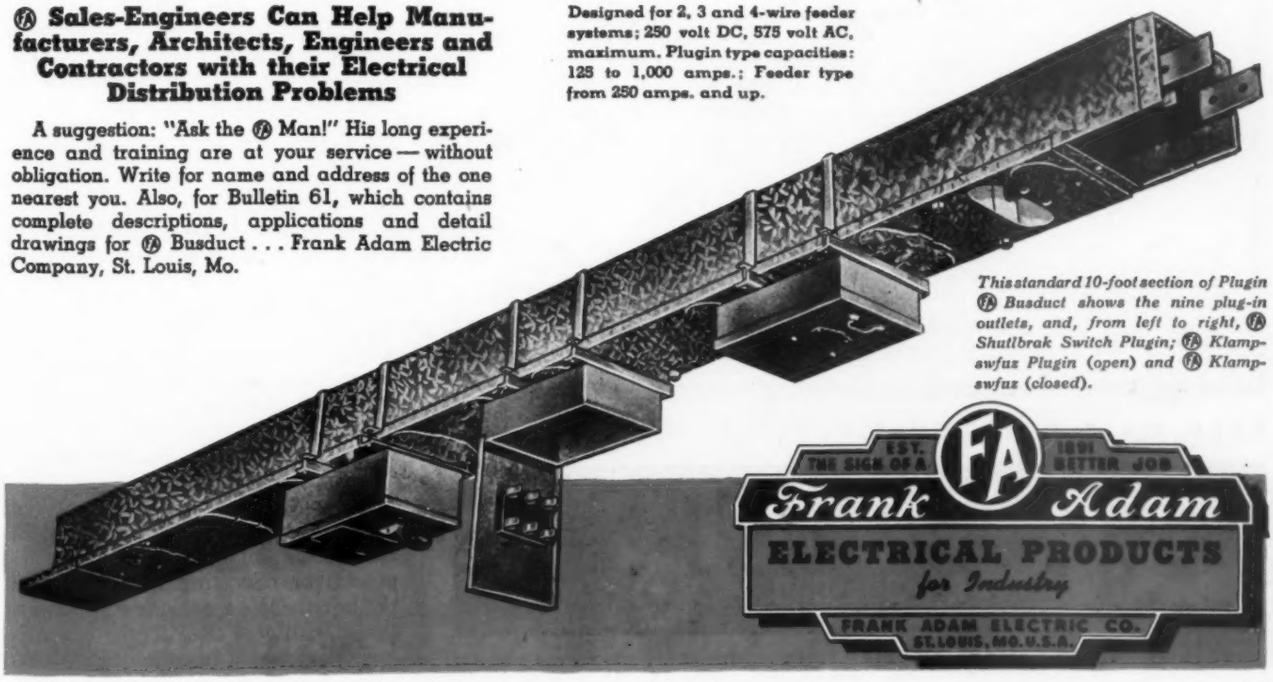
FA Sales-Engineers Can Help Manufacturers, Architects, Engineers and Contractors with their Electrical Distribution Problems

A suggestion: "Ask the FA Man!" His long experience and training are at your service — without obligation. Write for name and address of the one nearest you. Also, for Bulletin 61, which contains complete descriptions, applications and detail drawings for FA Busduct . . . Frank Adam Electric Company, St. Louis, Mo.

Designed for 2, 3 and 4-wire feeder systems; 250 volt DC, 575 volt AC, maximum. Plugin type capacities: 125 to 1,000 amps.; Feeder type from 250 amps. and up.



This standard 10-foot section of Plugin FA Busduct shows the nine plug-in outlets, and, from left to right, FA Shutlbrak Switch Plugin; FA Klamp-swfuz Plugin (open) and FA Klamp-swfuz (closed).

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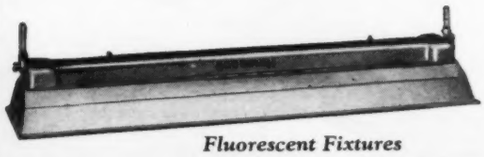

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sitioned and goes thus into production, replacing an equivalent tonnage of steel which would otherwise have to be purchased. Frequently the production department finds it easier to use reclamation stock, because it is already small enough to feed into the machine, whereas sheet or strip stock would have to be sheared into unit sizes before going into the press.

The department has become thoroughly familiar with specialized analyses used for perhaps only a few parts. Thus, when a batch of this scrap material shows up in the largest size in which it is ever available, the department labels it, "Hold for Parts 5B1106, 4B3816, or 1A652." Thus is avoided the possibility that it might be used for some undemanding purpose. Last year, 1,167 different kinds of parts totaling almost 1½ million pieces were made from this section's materials.

This department has become the maintenance department's important source of materials. No new-steel storekeeper was ever pleased to get a maintenance order for a few square feet of this sheet metal and a few linear feet of that bar. But such orders are welcome in reclamation, which is downright eager to find uses for what it has on hand. The consequence is that maintenance now draws between 30 and 50 percent of its total materials from the reclamation department—at no charge to itself, thus improving its own expense showing.

Salvaging Tools

High-speed tool steels are salvaged by the reclamation department in surprising volume. All purchased expendable tools carry the company's steel code symbol. Thus when the tool is worn out, the salvage crib knows exactly what it is. If possible, the tool is reworked to the next smaller usable diameter. But if its usefulness is over, it goes into a bin for eventual shipment to the source of this steel, where it can be used without loss of any of the alloying metals. There are 19 of these analysis code symbols, and considerable quantities of tungsten, molybdenum, chromium, cobalt, and boron are thus saved for this most effective and remunerative use. If analysis of a high-speed steel is not known, it is a spark tested.

Handling chips, turnings, and borings is at a location that four years ago seemed the best, but that is now recognized as too far from the foundry. As now laid out, this phase of the reclamation operation is not placed to the best advantage. So we are in the process of relocating major parts of the layout. We are taking for reclamation a yard area close to the foundry, and are planning to concentrate there,

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ARE A "MUST" IN EVERY DEFENSE PLANT!
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Capacity ¼ in. in steel, ½ in. in wood. Only 6⅝ in. long, weighs only 2¾ lbs. Fits the palm of your hand.
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If he does not know that your fire protection may be outgrown, he might *want* to be told. If he knew about the many astonishing improvements available in Cardox Systems — *to safeguard factory production* — he might vote for quick action.

A Cardox System permits immediate, automatic mass discharge of low temperature carbon dioxide at *any* or *every* fire hazard within its scope—tons at a time if needed! Result: Fire completely extinguished . . . combustibles and fire zone cooled below the re-ignition point . . . with no damage from extinguishing agent or from residue.

This story is far to great to tell here. We can mail you "Fire Extinguishing Fundamentals", a fact-filled booklet, and additional copies to any others you think should consider the new possibilities.

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out of doors and in a new building, all the operations of the ferrous and nonferrous metal reclamation.

We are, as part of the same program, placing chip pits at convenient locations around the plant to hold to a minimum the hauls of the chip wheelers. There will be ample pits to permit segregating all the alloys that we currently handle. All pits will be in bays served by cranes, and also they will be alongside the narrow-gage industrial railway that serves our entire plant. Thus, the crane can hoist the loaded box from the pit, place it on a narrow-gage flatcar, then set an empty box in the pit.

At present, because of the bulk of materials originating at the foundry for use in machining departments, the traffic on our narrow-gage railway is far heavier away from the foundry than toward it. Placing the metal salvage operations close to the foundry will help to balance up this transportation system, since the flow of scrap metal in the direction of the foundry will be a heavy volume of freight, providing loads for the narrow-gage cars which now travel empty in this direction. With this set of improvements in effect we expect to lower substantially the cost of handling our scrap, and also to increase the flow of scrap to the foundry so that all of the foundry's scrap needs should be met from within our own plant, probably leaving a slight margin.

Get Ready for Allocations

(*Continued from page 72*)

controls quantities of materials to be dished out to a specific industry or a specific firm, a rating system similar to the present priority plan will be necessary to control the timing of deliveries. Allocation involves a freezing of supplies and a direct government order sending specific quantities to specific customers at specific dates for specific purposes. A looser control over the scheduling of production and the timing of deliveries of finished products will be accomplished by the present rating system, or a variation.

Let's examine a little further the transition to all-out allocation. Accurate, stable allocations can't be made piecemeal. That is, you can't with any degree of precision allocate quantities of steel and rubber to the farm machinery industry without allocating, or at least knowing how much is to be allocated, to every other industry over which available supply is to be spread. Otherwise, available supply is apt to

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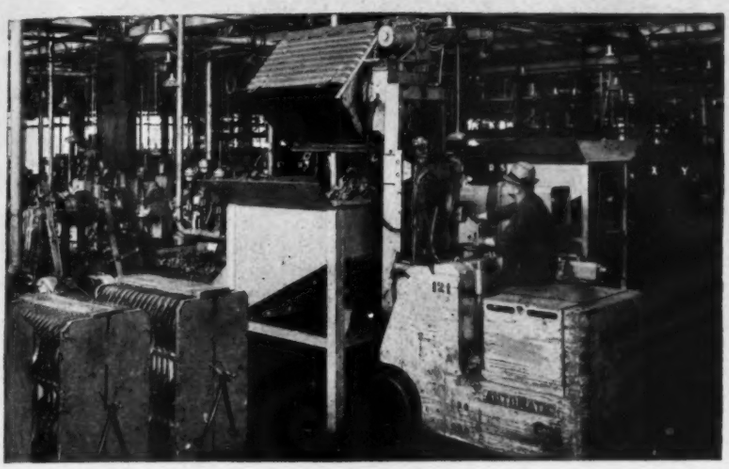

Model "CHTF" — Light-duty fork truck designed expressly for light unit load operation. Capacities 2000 lbs. Has full telescopic fork lift 120"—Collapsed height 83". Exceptionally compact for box car operation and narrow platform or aisle maneuvering.

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Model "LO-5"—For heavy-duty top-performance and efficiency to handle 10,000-lb. skid loads. Has standard platform 60" long, 26" wide, 11" high with 5" lift. Speed-O-Matic Drive control. Equa-poised drive and Dynatrol lift units.

Some of the Popular Types **of the "AUTOMATIC" line are illustrated here. They represent but a part of the many "AUTOMATICS" now serving American industry.**

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Model "TNN" Tractor with pneumatic tires. Has powerful spur gear drive, exceptionally compact and easy to maneuver. Rated DBP capacity 485 lbs. normal—2000 lbs. ultimate.

Model "LN-3"—For speedy transportation and placing of 6000-lb. skid loads. Has standard platform 55" long, 27" wide, 10¾" high with 6" lift—Spur gear, drive and lift units—Rotor-Brush control system.

★ LOADING

Platform Type "EN-2"—4000 lb. Capacity

Equipped with pneumatic tires. Exceptionally speedy and efficient. For outdoor and ramp operation.

Platform deck 100" long, 51" wide, 29" high. Has heavy duty spur gear drive—hand wheel steer — Rotor-Brush Power-Flow speed control.

★ STACKING

Model "THTF-L" — Fork truck offers new opportunities for lowest cost unit load handling and storage on pallets. Capacities 3000 to 7000 lbs. Standard telescopic lift 119"—Collapsed height 83" for box car operation.

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Model "TLN-3" — For 6000-lb. skid loads tiering plus transportation. Has standard platform 55" long, 27" wide, 10¾" high, 60" lift.

★ TIERING

High Lift Type

Model "TLO-5" — For heavy duty transportation plus tiering of 10,000-lb. capacity skid loads. Has standard platform 60" long, 26¼" wide, 11" high with 60" lift. The very latest in electrical control — construction styling and performance efficiency.

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Division of the Yale & Towne Mfg. Co.

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Now PRODUCTION Doubled-Trebled

NEVER before in the history of this great country of ours has the demand on industry been so great. It is production—faster, faster, faster! And faster production means systematic production. All work must move along easily, quickly, and efficiently.

American MonoRail Equipment increases and helps speed up production. It also reduces handling costs. It relieves men from lifting and carrying, and enables them to give full time to production. American MonoRail Equipment keeps materials and products on scheduled routes without congestion, delay, and damage in transit.

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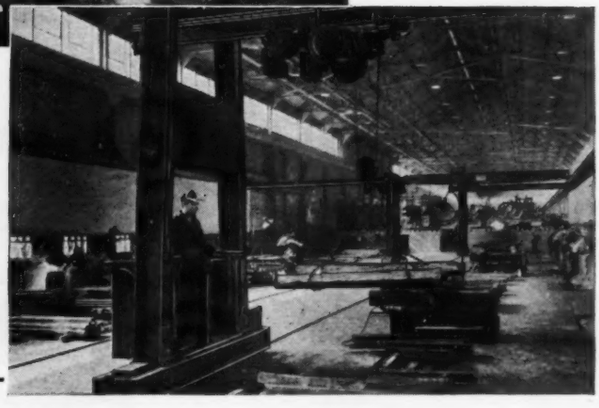

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be exhausted by allocations to half the groups to be taken care of. This means that initial allocations will have to be chopped up and re-allocated. Despite this difficulty, piecemeal allocations will probably be necessary to gear up to a complete program.

The moral for management is not to rely too heavily on a quantity of scarce materials allocated before all industries using those materials have received allocations. In planning production, don't overlook the danger that an allocation to your firm may later be cut down.

It's hard to visualize allocation until industry committees function much more actively than they have thus far. Allocation plans contemplate a big part for these committees. Final responsibility for allocations will rest with OPM or SPAB, but the industry committees will be counted on to furnish data on technical matters, trade practices and consumption, production, and other statistics. New steps will be submitted to industry committees for objections and suggestions. Industry committees, democratically selected by those *in* an industry, will be counted on to interpret allocation developments and procedures to the industry.

Active Part

Every company should pitch in and play as active a part as it can in the activities of its industry committee. Cooperation by submitting figures and records useful in getting its particular industry a proper allocation is sound management policy. It will also help an individual company to maintain good relations with government, and to keep informed on actual developments and future plans.

The Production Requirements Plan will bridge the gap between the present rating system and a full allocation program. It should be studied carefully. During the four or five months needed to shape up the much-talked-about allocation plan, the Production Requirements Plan will be the most important priorities procedure. Those who make products for defense or for essential civilian purposes should make every effort to fit in under this plan. Those who operated under the defense supplies rating plan will switch to this Production Requirements Plan.

Under the Production Requirements Plan, manufacturers are to estimate scarce materials requirements. Instead of ordering producers of required materials to deliver required quantities to a manufacturer—as would be the case under all-out allocation—the Priorities Division will issue a rating limited to approved

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Air-Maze engineers have developed a highly efficient acoustical chamber as an *integral part* of the Oil Bath, Multimaze and Unimaze type filters. Not to be confused with a silencing device merely "added-on" to filter, Air-Maze Filter Silencer Units provide exceptionally efficient protection against dust (99% *plus*) and, at the same time, eliminate all objectionable intake noises. Write for bulletin FSP-89.

Reduce the toll of dust-laden air! Provide your engines, blowers and air-compressors with the unsurpassed protection of

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Give your equipment adequate defense against the abrasive action of dust and grit. Install Air-Maze air filters and *prevent* excessive wear, needless overhauls and under-par efficiency. Air-Maze air filters assure *clean* air with negligible restriction of air flow. They are simple to install, easily cleaned and *will not clog* under normal conditions. Available in a complete range of sizes—oil bath and viscous types—cylindrical or panel design—and the Filter-Silencer units described at left. Write today for complete catalog.

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The Thermometer with the 3 R's

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Ruggedness . . simple all-metal construction withstands mechanical abuse around the active plant . . resists damage from vibration or over-ranging.
Readability . . large dial-type scales insure quick, accurate readings whether mounted on overhead lines or on equipment in hard-to-get-at locations.
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WESTON Thermometers are available in both angle and straight stem types, with stainless steel stems from 2" to 24", and scale diameters up to 6". Accuracy guaranteed within 1% for the industrial types . . . ½ of 1% for the laboratory type. Booklet containing complete information gladly sent on request. Weston Electrical Instrument Corporation, 628 Frelinghuysen Avenue, Newark, New Jersey.

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***All Metal* THERMOMETERS**

quantities of scarce materials. This rating cannot guarantee delivery. Its effectiveness will still depend upon the ratio of higher ratings issued to available supplies. However, as the Priorities Division develops a more complete knowledge of the ratio between the available supply of scarce materials and military and essential civilian requirements, ratings will be confined to available supplies. When reached, this degree of control will very closely approximate complete allocation.

Eliminate Red Tape

The Production Requirements Plan will eliminate the red tape involved in a mass of individual priority applications and extensions. It will make it easier to plan production in advance and make bulk rather than piecemeal buying possible.

The Production Requirements Plan can be used to obtain a rating for critical materials for the first quarter of 1942 and subsequent three-month periods. Application is to be made on Form PD-25-a to the Production Requirements Plan Section, Office of Production Management, Washington, D. C. This application form calls for complete and accurate data on:

1. The kind and volume of products which the applicant has been turning out.

2. The priority ratings carried by orders filled during the months of July, August, and September, 1941.

3. A similar breakdown showing the nature of the industry purchasing the product or end use of the product for the same months.

4. Inventories of all materials on hand.

5. Additional amounts of materials required to complete the calendar quarter's production schedule.

6. The use to which the materials have been put during the period being reported.

These data will give the Priorities Division a complete picture of the manufacturer's operations in relation to wartime and essential civilian needs. The rating may be applied only to the kinds and quantity of material authorized under PD-25-a. To assign this rating, the manufacturer is to place on each purchase order to which he wishes to apply the rating a prescribed statement, manually signed by an official duly authorized for the purpose, specifying the rating assigned, the preference rating order number, and the serial number. Those receiving orders carrying this endorsement may in turn extend the rating to obtain a delivery of materials which are to be incorporated in products called for by the original rated order. Exten-

sion is, of course, restricted to the terms and materials named in the original order. Note that those who qualify under this plan may not use other ratings to obtain production materials.

Don't overlook the fact that the rating issued under the Production Requirements Plan will be, at least in part, based upon the end use of products. In effect, ratings carried by incoming orders will be fused into a consolidated rating, or perhaps more than one rating, with that rating being carried over and assigned to material requirements. But where a substantial portion of incoming orders is unrated, the breakdown of sales according to end use moves into the foreground. If a large portion of incoming orders have been from customers essential to the economy—railroads, utilities, food—and are for essential uses in those activities, a rating high enough to assure delivery of material requirements will probably be granted.

Tucked away in the instructions is this significant statement: "Many manufacturers may have few defense orders although their products may be essential to the national economy. These manufacturers may be entitled to a high preference rating as well as a company working directly on defense orders."

A Vital Factor

The importance and the essentiality of the industries using a manufacturer's products will be a vital factor in determining the percentage of a manufacturer's scarce material requirements for which priority assistance will be granted. Finding customers who are apt to be given a high rating in any list of essential non-defense industries will improve any manufacturer's standing when he seeks an allocation of materials. As a guide to essential industries, there is a list of 75 industries which were considered essential by the National Defense Advisory Commission about a year ago. For an idea as to how these industries might be graded in importance, there is the industry classification used in the first World War. Still another guide may be found in the aluminum directory, issued by the Priorities Division, as a guide to aluminum producers in assigning non-defense rating to orders placed by their customers. Other industries may well be considered essential also, and these lists are not to be regarded as all-inclusive.

The lesson for management in this new recognition of essential civilian industry is that if it is impossible to convert to defense, the next best move is to convert to the production of vital non-defense products. Firms engaged in activity essential to civilian life and

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IT PRINTS WEIGHTS... FAST! In these days when speed is so vital in production, Toledo's answer is the Printweigh which combines unerring *printed* records with greatest *speed.*

IT PRINTS BIG FIGURES... *unmistakably big*... on thick tickets... on large or small sheets... on strips... with extra copies.

IT'S SIMPLE IN OPERATION! Prints *direct*... no complicated mechanism...*dependable*...operates in as little as 3/5 second.

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for bulletins and information to help you get greatest scale efficiency in your present plant or in your plans for new plant construction. Toledo Scale Company, Toledo, Ohio.

Take the pressure off your plant. SUB-CONTRACT YOUR SHEET, STEEL AND LIGHT PLATE WORK TO KIRK & BLUM. With modern facilities, manned by highly skilled workers, Kirk & Blum are well organized to design, manufacture and assemble sheet metal parts. Single units or quantity production can be fabricated with maximum speed and economy.

Take advantage of this specialized service and facilities — release men, machines and space for other work. We fabricate Stainless (all types) Aluminum, Monel, Brass, Copper, Angle and Bar Shapes.

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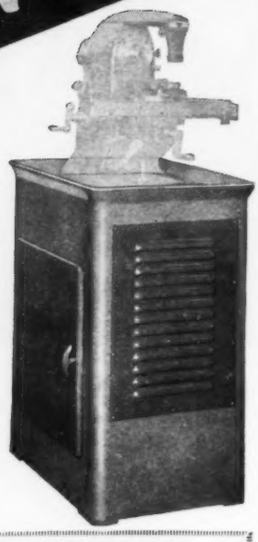

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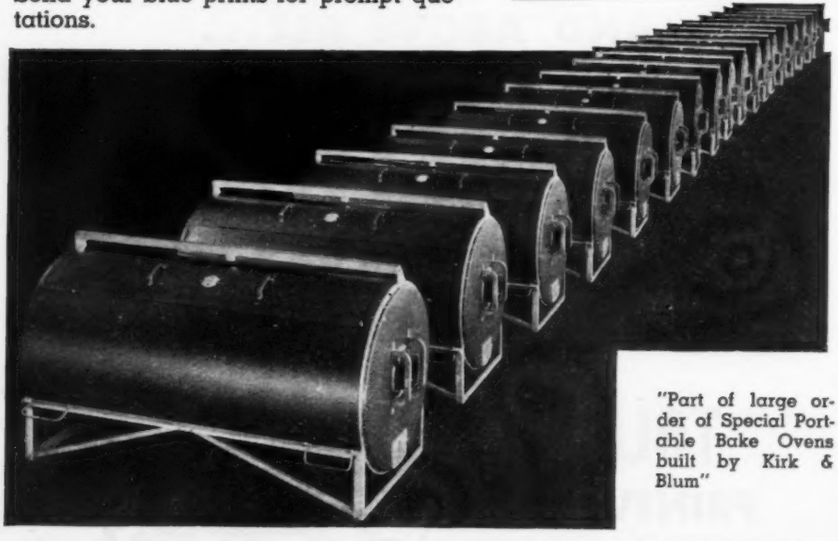


"Part of large order of Special Portable Bake Ovens built by Kirk & Blum"

THE KIRK & BLUM MFG. COMPANY

2835 Spring Grove Ave. **Cincinnati, Ohio**

to a fully functioning economy can survive. Remember that military requirements could consume all the magnesium and all the nickel we have. Even essential civilian activities will have to do without magnesium and nickel, where substitutes can be obtained. But if *some* nickel and *some* magnesium are necessary to keep non-military phases of the national economy functioning, a limited quantity will be taken away from military production. It is not good sense to produce powder in the middle west and withhold from the raliroads material required to transport the powder output to the seaboard for shipment or elsewhere for use.

Don't confuse this with "business as usual." Autos, refrigerators, washing machines, radios, and vacuum cleaners are typical of many products which will be cut more and more vigorously. But railroads, utilities, food, clothing, mining, and similar essential activities will get materials. Those serving these industries in an essential capacity will also be able to get materials.

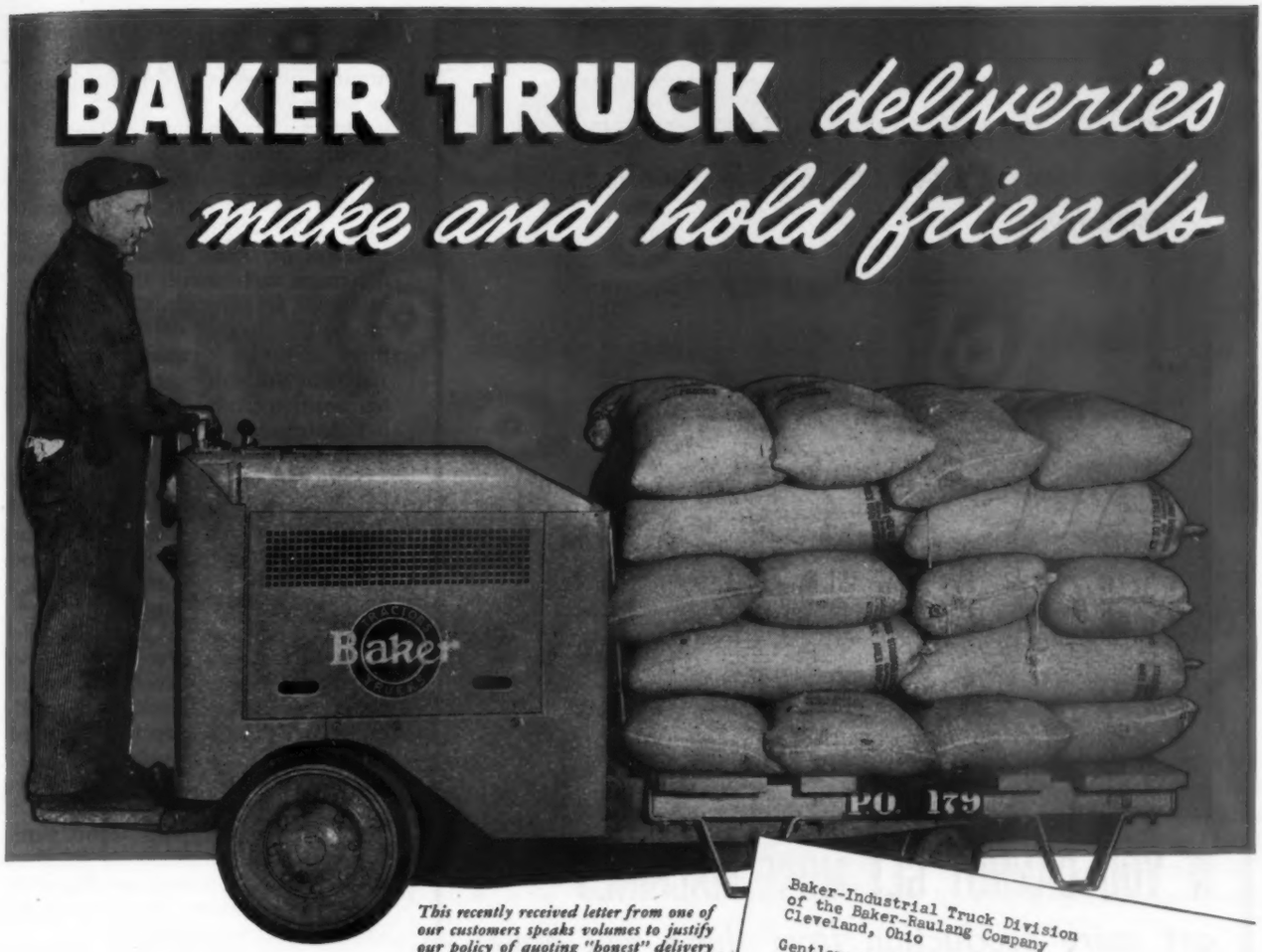
Whether or not you plan to operate under the Production Requirements Plan, it is good managerial strategy to prepare a detailed bill of materials and a breakdown of sales by preference ratings and end use similar to that called for in PD-25-a. The Production Requirements Plan is now an optional method of obtaining scarce materials. Total allocation will require the same kind of data of manufacturers seeking allocations of scarce materials. Start now to analyze shipments by preference ratings and to see that every order entitled to priority is accompanied by a preference rating certificate, a preference rating order, or properly enforced purchase order.

Indirect War Sales

It is equally important to trace indirect war sales. When definite identification of a contract or order as military is not possible, a manufacturer or distributor may still identify part of his business as defense by securing from his customer a "Customer's Certificate of Defense Requirements," Form PD-25-c (revised).

This certifies the percentage of total dollar volume sales made by the customer during a specified month which constituted defense supplies—Army, Navy, Maritime Commission, Coast Guard, and other specified government buyers; Lend-Lease; other orders carrying an A-10 preference rating or better; or materials to enter directly or indirectly into the manufacture of products for the previously mentioned buyers. A manufacturer may apply this percentage to all his sales to the customer submitting for

BAKER TRUCK *deliveries make and hold friends*



This recently received letter from one of our customers speaks volumes to justify our policy of quoting "honest" delivery dates. Name furnished upon request.

Baker-Industrial Truck Division
of the Baker-Raulang Company
Cleveland, Ohio

Gentlemen:

We greatly appreciate the advice from you that the Baker Truck we ordered has been set for shipment the week of March [illegible], 1942.

After being battered by some of the arbitrary letters the Purchasing Department has to quietly put up with in these times your letter comes as a very pleasant surprise.

No matter how far ahead the delivery date may be, or how difficult it may be to wait that long for badly needed material, when you can have confidence that your supplier is doing the best he can under the circumstances you may also have confidence that you have found a good supplier, and occurrences of that nature in these trying times will not be forgotten when we get back to selling merchandise instead of allocating it to our regular customers and hoping we are keeping our friends.

Yours very truly,

[illegible].

● Manufacturers faced with the problem of making good on quoted delivery dates in the face of present conditions will appreciate the following Baker record: During a recent two month period, 90.8% of our truck shipments were made on or ahead of schedule. Only 9.2% of the shipments were made after the scheduled date—none exceeding 11 days.

Thousands of Baker Trucks in service are showing this same dependability in performing their material handling duties. *Baker delivers the trucks—Baker Trucks deliver the goods.*

BAKER INDUSTRIAL TRUCK DIVISION
of the Baker Raulang Company
2178 WEST 25th STREET • • CLEVELAND, OHIO

Choose the type of drive that now is delivering nearly 2,000,000 h.p. in American industry!

IF YOU CANNOT GET MORE MACHINES . . .

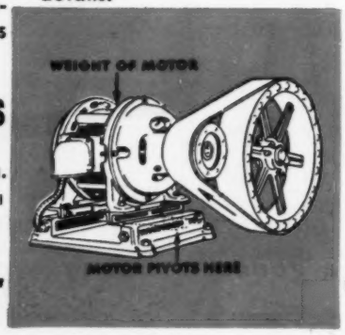
get more production from those you have!

Rhoads Tannate-Rockwood drives (your motor mounted on a Rockwood pivoted motor base and equipped with a Tannate Watershed Leather Belt) earn ever growing preference for *rightness* on the job.

Machines do more and better work. Maintenance is at a minimum. Power is saved. Correct belt tension is maintained automatically at all times. This saves wear on belt and bearings.

Use them —
- to step up capacity of present machines;
- to increase the productive rate of new machines;
- to keep machines on the job.

Tannate-Rockwood drives can be installed quickly and economically. Let us tell you how they can help you do your job. Write for details.



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New York • Chicago • Atlanta • Cleveland
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the ideal **SHORT CENTER DRIVE**

PD-25-c and consider the resulting amount as defense. Book records confirming this percentage method should be set up.

Distributors should be taught to identify customers' war orders by either specific identification or by percentage identification, by means of form PD-25-c (revised), or a combination of both. Have distributors determine each month the percentage of dollar volume of business which can be identified as defense, and have them set up book records to establish and maintain this percentage. Priorities position can be improved by favoring distributors whose records show the highest position of defense sales.

Sales and shipments should be similarly analyzed and recorded to show a detailed breakdown by industrial classification of customers, and by end use. This will help when, as is probable, a list of industries classified according to essentiality is released to guide allocation of materials for non-war use. Close control over inventories and detailed inventory records are equally important. The Production Requirements Plan—and all-out allocation—will call for full data on raw materials, work in process, goods in transit, finished goods, supplies, repair parts, and the like. Prepare now to place these data at the managerial fingertips and to synchronize inventory figures with material requirements.

As a matter of fact the one most important immediate practical step to be taken by management girding itself for allocation is to compile and have available full and complete statistical data on inventory, past consumption, future sales requirements. Here are the types of data to have on hand:

1. Inventory

(a) Stock of all materials.

(b) Orders placed for all materials, and scheduled shipments.

(c) Shipments of all materials received or enroute.

For the most part, this information is to contain details regarding the kind or shape of the materials or the content of the scarce materials in the product.

2. Consumption

(a) Past rate of operation (consumption) specifying the proportion of defense business to total business.

(b) Orders placed by customers, giving priority ratings of such orders and the intended ultimate use to be made of the product ordered.

(c) Shipments proposed, specifying priority ratings, and intended ultimate use.

3. Requirements

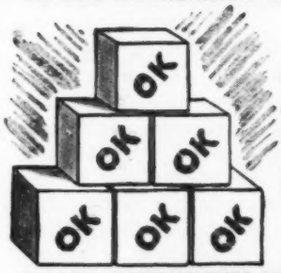
(a) Kind and quantity of the scarce material required to fill the

UNCLE SAM KNOWS THIS...

Taylor Instruments are doing NOT 1 BUT 5 *jobs for defense*

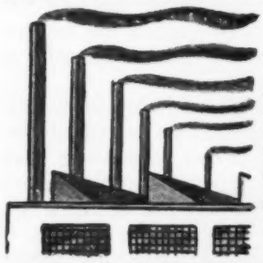
▶ Everything that Taylor makes is made to measure. Every instrument that Taylor makes for Industry is designed to indicate *precisely*, or record *precisely*, or control *precisely*. Taylor-made precision protects Industry's power to produce today. These are the jobs —*not 1 but 5 jobs*—that Taylor Instruments are doing for defense:

TAYLOR INSTRUMENTS HELP MAKE BETTER PRODUCTS



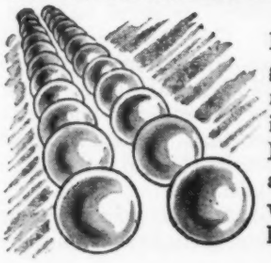
Constant top-grade perfection comes from using Taylor Instruments, because they permit complicated processing operations to be carried on automatically.

TAYLOR INSTRUMENTS HELP SPEED UP PRODUCTION



With Taylor Instruments on guard over industrial operations, insuring automatic precision, products can be turned out faster. Mishaps due to human errors get far less chance to gum up the works.

TAYLOR INSTRUMENTS HELP INSURE UNIFORMITY

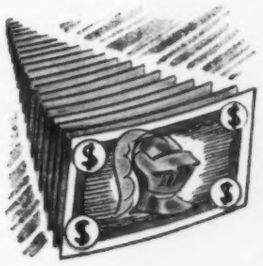


Exact duplication of operations, guaranteeing exact duplication of mass-made products, can be indefinitely carried on if Taylor Instruments are used to record and control those operations with the automatic exactness that human skill can't match.

TAYLOR INSTRUMENTS HELP FREE MANPOWER

Skilled employees in a Taylor-equipped plant do much less "sentry duty" merely watching over operations. They are freed for other more essential work. Taylor Instruments are automatic industrial sentries.

TAYLOR INSTRUMENTS HELP MAKE DEFENSE DOLLARS GO FARTHER.



Uncle Sam is likely to get more of the best for his money from plants using Taylor Instruments. Why? Because, by using Taylor Instruments, these producers often can cut their production, maintenance, and labor costs noticeably and can sell to the Government at lower prices without cutting profits!

Taylor Instruments should be doing these five—not one but five—jobs for you, too. We want you to be getting 100% satisfaction from your present Taylor Instruments, and we're here to see that you do. Perhaps we can suggest ways to improve your instrument performance. We've had plenty of experience in this industrial instrument business. How can we help you most? Taylor Instrument Companies, Rochester, N. Y. Plant also in Toronto, Canada.

Taylor-MADE MEANS BETTER MADE IN AMERICA BY AMERICANS

The New Taylor Fulscope Controller protecting America's power to produce with **not 1 but 5** *forms of control.*

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TEMPERATURE, PRESSURE, FLOW *and* **LEVEL INSTRUMENTS**

VITAL
"Air Wardens"
of INDUSTRY
PANGBORN Dust Collectors are silent sentinels standing guard over large and small industrial plants.
Wherever dust is produced they quickly, efficiently and economically collect it at its source—protecting your products, your equipment and your working conditions.
Don't fool yourself about DUST. It is a BIG problem in EVERY PLANT. Yet it can be CONTROLLED. For interesting data and bulletins "COME TO PANGBORN"—and get valuable facts about these vital "Air Wardens" of Industry. No obligation, of course.
PANGBORN
WORLD'S LARGEST MANUFACTURER OF DUST COLLECTING AND BLAST CLEANING EQUIPMENT
PANGBORN CORPORATION · HAGERSTOWN, MD.

orders on books (again specifying rating and ultimate use) and expected orders.

4. Supporting Evidence

(a) Proportion of defense business to total business.

(b) Proportion of the scarce material to the total value of product.

(c) Number of men employed and number threatened with unemployment if no material can be obtained. Number of men employed per unit of scarce material used.

(d) The extent to which substitutes are being used and resulting savings in material; or the impossibility of using substitutes and reasons.

(e) Efforts made to secure the scarce material.

(f) Efforts to subcontract.

(g) Ratio of various types of priority controlled material to other types of materials entering each product.

To realize the vital importance of detailed records and statistical data, and of tight control over raw material usage, wartime mobilization's impact on our national economy must be understood. The test of business success veers away from the financial profit-and-loss statement to a composite portrait reflecting efficiency on material consumption, production per unit of material consumed, men employed per unit of material, and speed of production.

To be sure, it is still necessary for industry to make enough money to pay the bills. But continued revenue depends on continued flow of materials. In a war economy, scarce materials will be choked off unless a manufacturer produces armaments for the government or essential civilian goods. In producing armaments, the emphasis is on speed and quantity of output, rather than on cost. In producing essential civilian items, revenue will depend upon how much can be produced out of the limited quantity of materials allocated.

A major result of industrial mobilization in Germany was a radically revised system of cost accounting. Germany is cited as an example because total war compels total mobilization, and the framework and controls of which are essentially the same regardless of geography, national temperament, or pre-war political and economic forms. This German standard system of cost accounting emphasizes *quantities* of materials used rather than the cost of materials; men *employed* rather than *money costs* of payroll; *quantities shipped* rather than *proceeds of sales*.

To contribute most effectively to war production, management must be

Look to CENTURY for

Correctly Protected Electric Motors for Hazardous Conditions

SPLASHING LIQUIDS
FALLING SOLIDS

Plant wash down — below work line protection against falling chips — splashing cutting oil. You do not need an extra dog house to protect the motor.

Use Century Splash Proof Motors

ABNORMAL ATMOSPHERES
ACID AND ALKALI FUMES
ABRASIVE DUSTS

Air saturated with oil or animal fats — current conducting or corroding dust — organic and inorganic acids — aklalies, etc.

Use Century Totally Enclosed Fan Cooled Motors

GASOLINE AND GASES
EXPLOSIVES

Protection against atmospheres containing explosive quantities of gasoline, petroleum naphtha, alcohols, acetone, lacquer solvent vapors, and natural gases (Class 1, Group D) or explosive grain dust (Class 2, Group G)

Use Century Explosion Proof Motors

★ Century Motors are built in such a wide variety of kinds, types, and sizes up to 400 horsepower that it is an easy matter to select and properly apply the *right* motor for every job regardless of load and operating conditions. 245

If you are engaged in war work of any kind, get the facts on Century protected motors by calling in a Century Motor Specialist — there's one near you.

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ONE OF THE LARGEST EXCLUSIVE MOTOR AND GENERATOR MANUFACTURERS IN THE WORLD

Cannon Over the Clouds!

FAMED Bell Airacobras

built and serviced with aid of

Snap-on Tools

Bell Aircraft Corporation's remarkable speed-production of the sensational "Airacobra" pursuit-plane is now legend . . . from experimental stage to mass assembly line output in less than 300 days!

The part played in this production epic by Snap-on speed-designed tools is best stated by Airacobra's builders: "The compactness of advanced aircraft design such as the Airacobra requires flexible tools that are strong and reliable. We use Snap-on tools because they fill this bill best for Bell Aircraft Corporation."

Everywhere in industry today, Snap-on tools are proving that their extreme accuracy, swiftness in service, and wide range of application are literally "made-to-order" for the emergency . . . *vital to victory!*

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NATION-WIDE TOOL SERVICE FROM 35 FACTORY BRANCHES

Snap-on tools are "speed-distributed", too . . . at key industrial centers throughout America are 35 fully tool-stocked factory branch warehouses from which 550 trained representatives travel daily schedules to offices and factories, bringing Snap-on's line of 3,000 tools direct to desk or bench to "see and try before you buy." Snap-on tools can help you *now*. For catalog and full information, write . . .

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Snap-on Tools
for Production, Service, Maintenance

geared to handle changes in produciton plans quickly and with economy in materials and machine tools. The inevitable changes in military requirements enormously complicate any priority—or allocations—system. A specific quantity of each material may be allocated for the production of a specific model tank, rifle, plane, or machine gun. When military requirements dictate a switch in model, the original allocation is thrown out of line. Inventory control must be geared to show quantities of each material on hand and of additional materials called for by revised production plans.

Not Clearly Marked

Bear in mind that the details of allocation have not yet been clearly marked out by defense authorities. This article has presented only the outlines and the philosophy of allocation. Great emphasis has been upon the factors that will carry important weight in alloting materials. The central point which the author wants to hammer home is that management, to do its war job, must be alive to the possibilities that allocation holds, keep itself alert for developments as they occur. Policy must be sufficiently flexible to permit swift action in whatever direction an uncertain future dictates.

"Meet Mr. Budget"

(*Continued from page 97*)

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set-ups in particular, and the whole set-up in general, can be constantly improved for better and more practical operation.

In discussing the budget we wish to emphasize that its application to the Stetson Company's departments, in addition to setting up projected costs, is to embody scheduling and flow of production.

Our budget has three basic features:

Time—When we make plans for the future we have in mind a given period of time. In our company we control operations from week to week and from month to month. The yearly budget or forecast is divided by 52 to give the weekly budget and the weekly budget is multiplied by 4 or 5 to give the monthly control. We do not use calendar months, but 4- or 5-week periods approximating the calendar months.

Activity—This refers to the amount of work such as hats, blocks, boxes, ribbons, we produce in a given period of time. However, we know we must

LOOK OUT FOR RUST

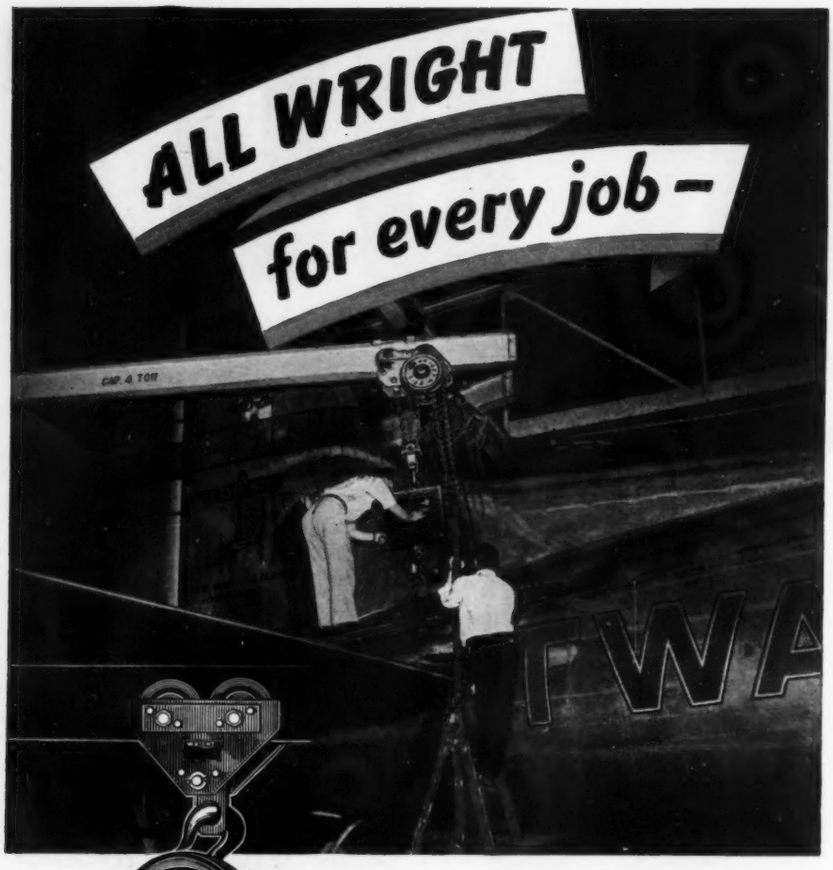
IT'S no news to you that rust can play havoc with turbines. A year ago there wasn't much you could do about it. Then came *new* Shell Turbo Oil. Now a field-tested, service-proved turbine oil that has made history . . . the first to meet all 3 vital needs of modern turbine lubrication . . .

RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY

Why accept less?
Call in Shell today.

SHELL

Protect YOUR turbines with
SHELL TURBO OIL



large or small—special or routine

Regardless of whether your work demands special application or routine handling—whether it be 500 pounds or 40 tons—whether an electric hoist, a hand-operated high-speed hoist, traveling crane, or monorail trolley—Wright engineers know how to solve your problem *economically*.

Here are three things you get in every **WRIGHT HOIST:**

1. SAFETY. The load chain has a safety factor of 7 to 1. The bottom hook which is drop forged from special steel, acts as a safety governor, in that it gives warning of overload by slowly opening. These hooks possessing an unusual degree of ductility will straighten out before any part of the hoist is damaged, plus acting as a warning to the operator.

2. EFFICIENCY. **WRIGHT HOISTS** are fast, smooth and positive in action because of scientifically engineered design.

3. DEPENDABILITY. **WRIGHT HOISTS'** rugged and precision design assures year-in and year-out durability and the very minimum of maintenance cost.

Let Wright engineer your hoisting and crane problems. Work through the Wright distributor in your city. You'll find him listed in the classified telephone book.

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WRIGHT MANUFACTURING DIVISION
YORK • PENNSYLVANIA

In Business for Your Safety

AMERICAN CHAIN & CABLE COMPANY, Inc. BRIDGEPORT CONNECTICUT

have a common denominator into which we can translate these varied items, if we wish to measure the overall activity of a department or the factory.

Money—This is the common denominator for measuring our activity. The labor cost of doing certain operations can be easily obtained by multiplying the piecerate by the number of units. This is the standard direct labor cost. Overtime adds to the standard cost. Each foreman is presented with a schedule showing the amount of work that should go through his department in a given time, and the standard direct cost allotted to his work. A weekly schedule of work, set up previously for each department, is considered 100 percent activity. If, for instance, it is set at $10,000 for the week and the department produces only $8,000, it is said to be operating at 80 percent activity.

It is particularly important that the foremen understand and use the "activity" percentage, for only by knowing the activity of his department can a manager plan ahead and control his use of men, materials, and money. If the activity is high the manager must gear his operations accordingly to produce his budgeted amount. If activity is low, he must curtail operations to avoid waste.

By knowing exactly the relation between activity and his use of personnel and materials the manager can plan his operation at various levels.

Three Relationships

There are three kinds of relations between activity and the use of men and materials—fixed, variable, and curved.

A fixed activity is one in which the use of personnel remains "fixed" at a constant figure, regardless of high or low activity. For example, a salaried supervisor draws his salary 52 weeks a year, regardless of whether the department is running at a high or low activity. He even receives his pay when he is not working, through sickness or vacation.

A variable activity is one which varies in direct proportion to the activity of the department. Consider renovation. When a department is not producing any hats at all, there is no renovation to be done. When a department is operating at 100 percent activity, we consider the renovation involved at 100 percent. In between these two points of activity, the amount of renovation to be done should always be in direct proportion to the activity of the department. For example, at a departmental activity of

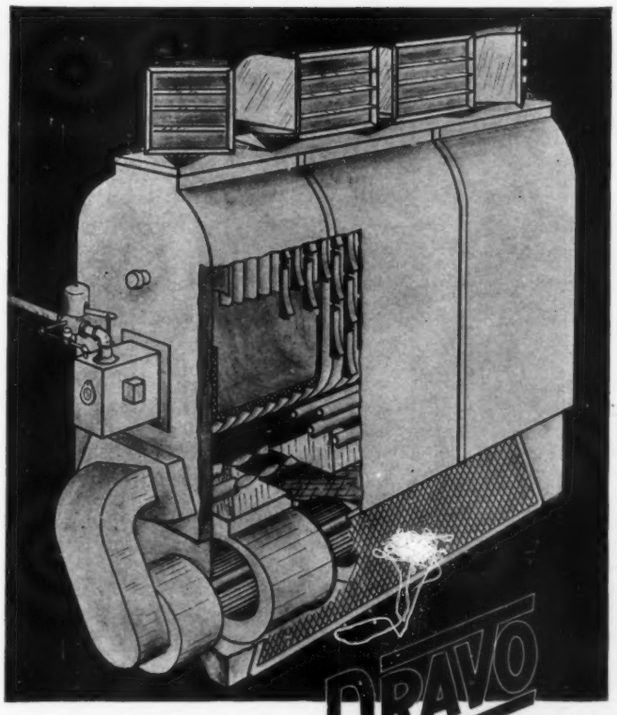
DIRECT FIRED HEAT

Quickly and Cheaply

DRAVO HEATERS

the answer

to your heat problems on quick construction for defense . . .



● New plants . . . additions to existing structures may be heated at surprisingly low cost during construction and permanently after completion with Dravo Direct Fired Heaters.

These heaters provide inherent advantages of low initial and operating costs and flexibility of installation. Burning gas, oil or coke oven gas, they produce proven heat transfer efficiencies up to 85%. Air is warmed and delivered when and where needed—instantly—economically—showing distinct savings over conventional heating systems.

Stock sizes with 750,000 to 1,500,000 B.t.u. output are available. Group installations can be arranged to heat any large industrial building.

We are prepared to quote on the bare units or complete installation. Dravo Bulletin No. ENR-502 contains complete, usable data and will undoubtedly save you weeks of time. Time was never more precious—if your job requires heat quickly and economically for years to come—consult or write—

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MACHINERY DIVISION HEATER DEPARTMENT

Broad St. Station Building, Philadelphia, Pa. 300 Penn Ave., Pittsburgh, Pa. 4800 Prospect Ave., Cleveland, Ohio

KRANE KAR SWING BOOM TRACTOR CRANE

3 SIZES:
2½, 5, & 10 ton capacities

VITAL POINTERS TO SPEED-UP AND SAFETY

→ VISION is unobstructed
→ BOOM TOPPING with *full* load
→ STABILITY *without* stabilizers
→ TRACTION INCREASED with load
→ AUTOMATIC BRAKES
→ EASY STEERING with load
→ SIMPLICITY of control

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Send for Bulletin 55, with illustrations and specifications

SILENT HOIST WINCH & CRANE CO.
855 63rd ST., BROOKLYN, N.Y.

The Handiest Glove Ever Made

Edmont
WORK-TESTED GLOVES
FOR HANDLING WET, ROUGH, ABRASIVE MATERIALS, AND CORROSIVE CHEMICALS

Sturdy as the tread of a tire and wears as well. Gives full protection to the hands. Does not bind. Slips on and off easily, which is an added safety factor. Soft fabric lining allows greater hand comfort and prevents rubber snagging. Seams sealed against wear and tear. Will outlast several pairs of ordinary gloves.

KNIT WRIST STYLE–For General use. Gives exceptionally long wear. Available in varying weights.

OPEN VENTILATED BACK STYLE – Rubber coating on palm and fingers only. Sanded-rough finish. An all around, durable work glove noted for long wear economy.

SYNTHETIC RUBBER STYLE – Extra heavy weight for handling chemicals, oils and solvents harmful to natural rubber. In knit wrist or gauntlet styles and varying lengths.

GAUNTLET STYLE – Water proof and acid resisting. Ideal for handling wet and corrosive materials. Available in 5-, 6½-, and 10½-inch cuffs in both extra heavy and heavy weights.

A Style to Serve Every Industrial Need.

Available through leading distributors. Write direct for description, prices and samples.

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50 percent, the renovation should also be 50 percent of the 100 percent normal renovation.

A curved activity is one in which the relation of the particular account to departmental activity is neither fixed nor variable but somewhere in between. For example, some accounts such as stockkeeping require a certain amount of personnel to be on hand, even at zero departmental activity. At 100 percent departmental activity, the stock account requires more personnel than it does at zero activity. Therefore, it is neither fixed, nor does it vary in direct proportion to the departmental activity. The relationship between departmental activity and such an account is best represented by a curve rather than by a mathematical formula and therefore the account is called a curved account.

In planning ahead, the first step for the planner is to have some idea about the quantities of work that he will produce in a given period. Then it becomes easy for him to forecast in his budget direct labor costs, as well as his fixed, variable, and curved costs.

Today we are so sold on our budget that we believe we could not operate if we had to go back to our old method of having top management settle all details in each foreman's department. With our present set-up we have what I should call properly controlled decentralization. Each foreman knows what he should accomplish. He has latitude in his responsibility, and we have a check on his results; consequently we do not have to worry about the way in which he gets them. Certain departments which were formerly looked upon as financial and operating problems have become today, through the use of our budget, star departments.

•

Factory Management and Maintenance is a consolidation of *Factory and Industrial Management* and *Maintenance Engineering*.

Factory and Industrial Management grew from consolidations, mergers, or absorptions involving the following publications: *The Engineering Magazine; Industrial Management; Factory, the Magazine of Management; Management Engineering; Administration; Management and Administration; Management and Administration in Manufacturing Industries; Manufacturing Industries.*

Maintenance Engineering grew from consolidations, mergers, or absorptions involving the following publications: *Review of the Telephone and Telegraph; Electrical Review; Western Electrician; Electrocraft; Electrical Engineering; Electrical Review and Industrial Engineer; Industrial Engineer; Industrial Engineering; Industry Illustrated.*

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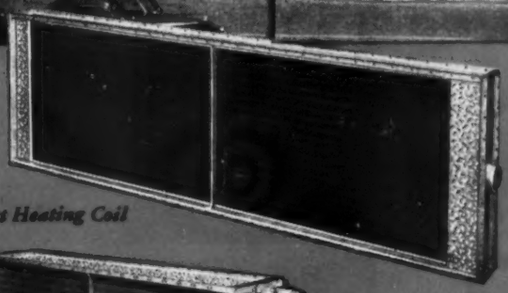
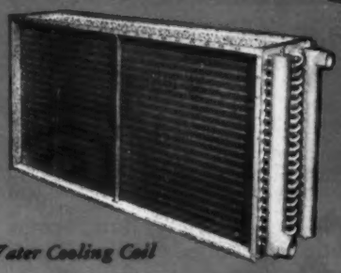


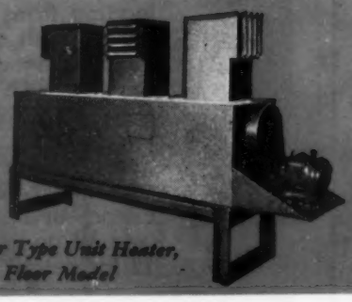
Blast Heating Coil



Water Cooling Coil

Standard Unit Heater

Down Flow Unit Heater



Blower Type Unit Heater, Floor Model

Actively Engaged!

McQUAY COILS HEAT AND COOL THE NEW WAR DEPARTMENT BUILDING IN WASHINGTON

DAY and NIGHT—McQuay is actively engaged in supplying *Proven McQuay Products* for National defense projects, such as the heating and cooling coils in the newly completed War Department Building in Washington, D. C.

McQuay Standard, Down Flow and Blower type Unit Heaters, as well as Convectors, are also on the job, providing essential industrial temperature control in many U. S. Air and Naval Bases, Cantonments, Munition Plants, Armament Factories, as well as in Aircraft and Naval vessels.

When specifying dependable McQuay heating and cooling equipment, you are enlisting the services of an organization dedicated to the building of Quality products and delivering them on time.

McQUAY, INC., 1620 Broadway Northeast, Minneapolis, Minnesota. Representatives in principal cities.

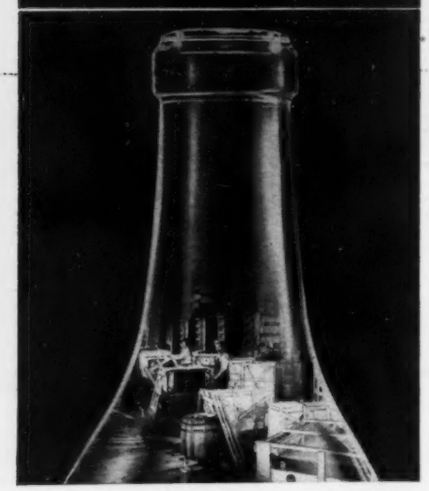
SEE US AT THE PHILADELPHIA SHOW • BOOTHS 310-312-314

One of a series of advertisements depicting the part of McQuay, Inc., in the defense program.

McQuay INC.

AIR TEMPERING EQUIPMENT
ESPECIALLY DESIGNED
FOR INDUSTRY

DON'T LOSE
DEFENSE PRODUCTION GAINS
HERE!



● Production has been stepped up to meet defense needs—only to have many of those gains lost in the shipping room. There must be no delay in the delivery of defense products. General Box standard and specially designed shipping containers are helping hundreds of manufacturers to smash the shipping room bottleneck. In addition, damage is eliminated—hours and dollars are saved—valuable shipping room space is conserved.

Why not see how General Box crating engineers can help you in the shipping of your defense products? They will be glad to work with you in determining the box, crate or special container which best meets today's requirements.

13 PLANTS STRATEGICALLY LOCATED

There is a General Box plant near you with the production facilities and modern equipment to make containers for practically every type of product. They can help your shipping room keep up with your defense production.

SEND FOR THIS FREE MANUAL

Important economies are being made through the use of General Boxes and Crates. This illustrated booklet shows how products similar to yours are being delivered faster, safer and more economically. Mail the coupon!

GENERAL BOX COMPANY

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Send a free copy of the new manual, "How Research Can Save $$ for You."

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Management Shorts

(*Continued from page 100*)

basis one can readily appreciate the importance attached to time studies.

In the past, it was customary, when called upon "to place a price on a job," to time the machinist while he turned out half a dozen or a dozen completed pieces, and place the computed production and price on the office master card.

However, there was something lacking with this method—there was an insufficient amount of personal contact. The operators began to feel that they were being slighted, and imagined the time study engineer to be a natural enemy rather than a liaison man between management, supervision, and labor.

It was decided, therefore, to issue future time studies in more detail. Thus, each phase of every operation was studied individually, and the operator was asked to sign each study. The feed and speed, as well as the type of lubrication used, were noted.

Then the computed production and price, as well as the feed, speed, and type of lubrication were entered on the office master card and on a production envelope that was issued for each job and sent along with it to the machinist for whom it was scheduled.

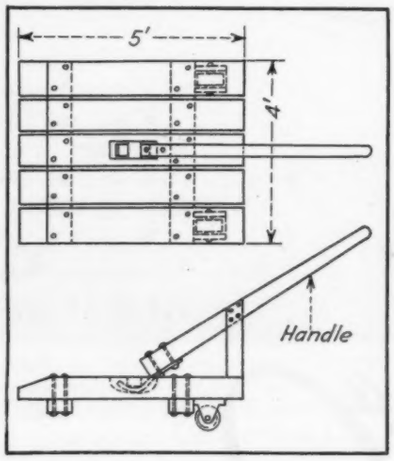
At present, in spite of the sudden steep climb in production and the constant high-quality requirements, everything is flowing along smoothly.

•

Platform Simplifies Box Car Unloading

W. F. GOEZ, Superintendent, Iowa Fiber Box Company, Keokuk, Iowa

The platform as shown in the sketch is placed between freight car and unloading dock to facilitate unloading of paper rolls. The handle, which is about six feet long, eases the job of putting the platform in



A "CYCLONE" in NAME ONLY

THE *Improved*
"CYCLONE"
DUST COLLECTOR
that Performs Like a More Expensive System

This high efficiency, long cone Cyclone dust collector is outstanding in performance—in fact, actual collecting efficiency is within a small percentage of the results obtained with filter type collectors: and it compares very favorably with the average wet system.

Due to its low cost and high efficiency, it has been accepted by leading firms for collecting such materials as grinding and buffing dust, foundry sand, sugar and rubber dust, etc.

The phantom view, at left, illustrates the cyclonic principle utilized. Write for Bulletin 12 for details.

AMERICAN FOUNDRY EQUIPMENT CO.
374 S. BYRKIT ST.
MISHAWAKA, IND.

DIRT INFILTRATION ELIMINATED

by using PC Glass Blocks at the American Electric Fusion Corp.

Architect—Arthur J. Sir

The American Electric Fusion Corporation plant at Chicago, Ill., is one of the many modern industrial plants where the use of PC Glass Blocks has proved beneficial. The plant is air-conditioned, ideal for the operation of precision machinery. The insulation provided by the blocks helps keep room temperatures and humidities uniform. The big panels of PC Glass Blocks transmit and diffuse daylight, giving workmen good light to work in. And the glass block panels keep out dirt and grit that might harm delicate machines.

Not a speck of dirt comes through daylight-transmitting areas when they are sealed panels of PC Glass Blocks. This is vitally important for protection of many products —such as precision machinery, textiles, sanitary products, chemicals and foods.

Cleaning is simple. A man using a long-handled brush can make a big panel of glass blocks spic and span in a few minutes. And because the diffusing properties of PC Glass Blocks make small dirt particles less noticeable, cleaning is not often required.

Prompt delivery! We have big stocks of glass blocks on hand in a variety of patterns — and ample facilities to handle big orders quickly.

Get the facts about PC Glass Blocks now. Find out how their combined light-transmitting and insulating properties can help you reduce maintenance costs and improve plant operation. Send for our big, free book that shows how they are being used successfully in many plants today. Just mail the coupon below.

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GLASS BLOCKS

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PITTSBURGH PLATE GLASS COMPANY

and by W. P. Fuller & Co. on the Pacific Coast

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Please send me your free, illustrated book that tells how to use PC Glass Blocks in industrial plants.

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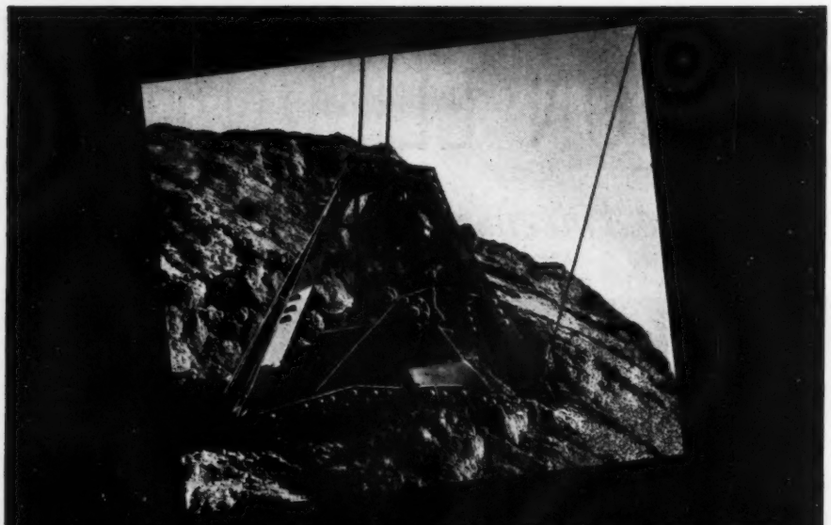

YOU CAN BANK ON A BROWNHOIST BUCKET

Industrial Brownhoist buckets represent the last word in good design and construction. Light weight is combined with unusual strength. Rope wear is reduced to a minimum. Because of the clean, deep bites they take, hand shoveling is practically eliminated. Standard buckets on hand ready for immediate delivery. Write for further facts.

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SHORT CUTS to SAVINGS through OAKITE cleaning

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SAFELY REMOVING SCALE DEPOSITS FROM WATER-COOLED EQUIPMENT!

For a safer, easier way to de-scale Diesel cooling systems, "lube" oil and jacket water coolers, ammonia condensers, feedwater heaters, etc., try Oakite Compound No. 32. Saves time, and money . . . Eliminates need for costly, time-consuming mechanical methods. No dismantling of equipment! Circulation of recommended solution as directed thoroughly yet SAFELY removes scale deposits, quickly restoring normal heat transfer efficiency.

Write for NEW, FREE, 24-Page Data Manual!

Gives money-saving tips on de-scaling over 24 different types of water-cooled equipment. FREE on request . . . write today!

OAKITE PRODUCTS, INC., 14A Thames St., NEW YORK

Representatives in All Principal Cities of the United States and Canada

OAKITE Specialized CLEANING

MATERIALS · METHODS · SERVICE — FOR EVERY CLEANING REQUIREMENT

place, and is removable after the platform is in place. By using the handle and wheels it is possible for one man to handle roll paper, thereby creating a saving of 17 per cent in unloading cost.

The loading dock is eight inches lower than the car door so that the floor of the car is level with the platform of our electric truck. This same idea could be used where dock and car floor are on the same level, simply by placing the wheels on the handle rather than on the platform.

This arrangement makes, in effect, a two-wheel truck out of the platform—the two wheels on the platform remaining on the unloading dock at all times. This makes it possible for one man to handle this platform; previously, two men were needed.

•

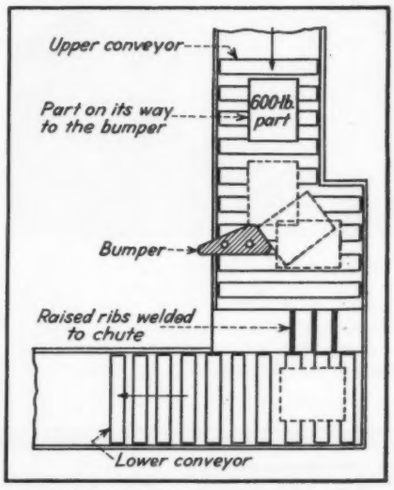
In an English laundry, girls wear dresses with different colored stripes — pink, blue, lavender. Each color has its place in the process line. So, if the manager sees a pink stripe, for instance, where only lavender stripes should be, he knows something is amiss, and investigates.

•

Three Ribs and Bumper for Automatic Handling

DANIEL BERG, Bridgeport, Conn.

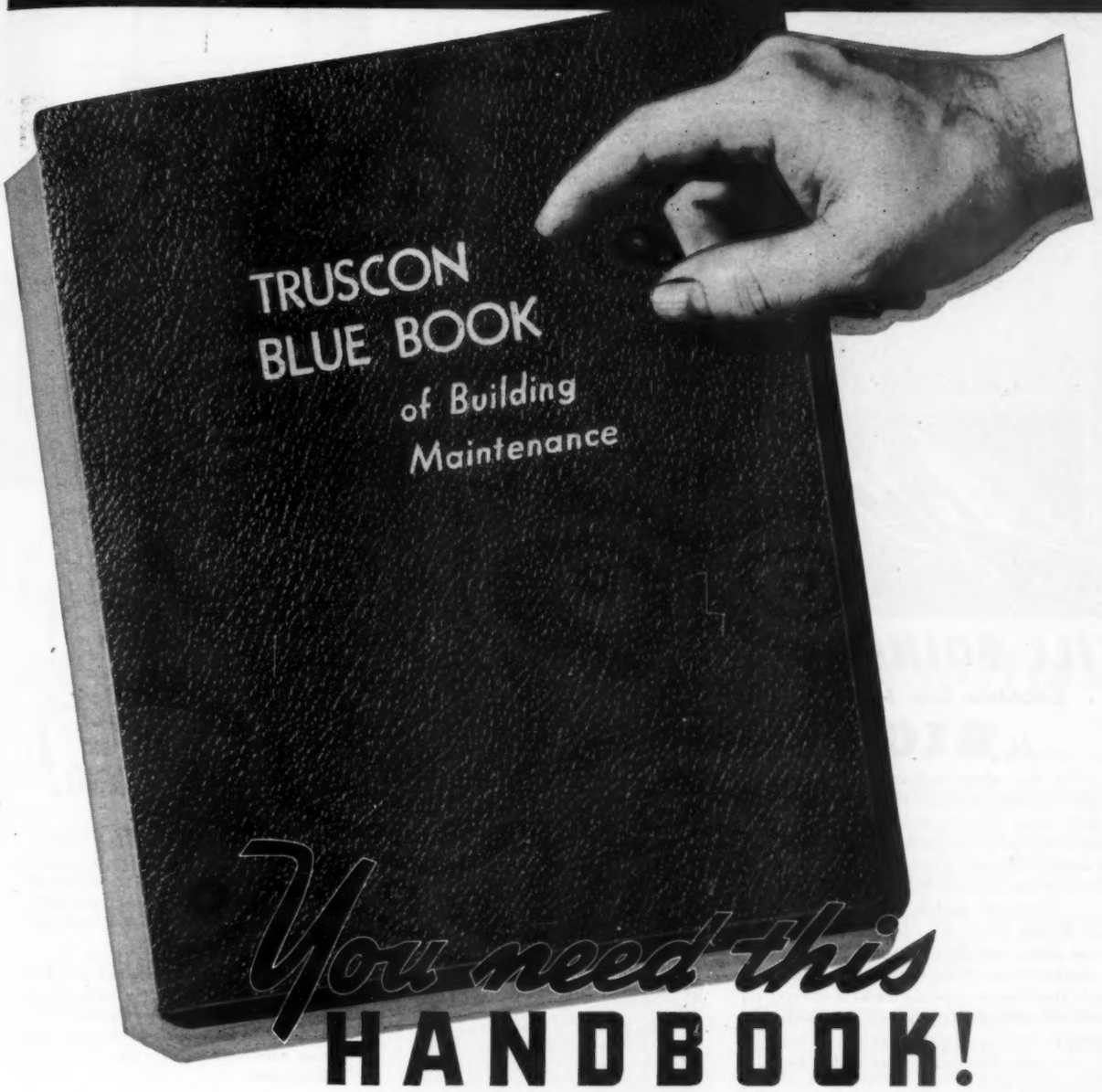
A part weighing over 600 pounds, and with a friction bearing surface of about 600 sq. in. has to slide down a chute into a conveyor which runs at right angles



to the chute. This chute has a smooth steel bottom, and the part used to stick on the chute at times. As it was a time operation, a man had to be kept in readiness, and by using a hook and with a great deal of manual pull, he was able to get the part going again.

This problem was entirely overcome

MAINTENANCE EXECUTIVES



You need this HANDBOOK!

Trade mark registered

It simplifies your building maintenance problems. It tells you HOW—to harden cement floors—to rust-proof steel sash, tanks and structural work—to slip-proof floors and landings—to dust-proof cement floors and stairs—to acid-proof steel work—to protect and restore wood floors—to reduce sun glare—to waterproof new construction—and how to get efficient, economical solutions to many more maintenance problems.

FREE—to plant maintenance executives. Request must be written on business stationery to Dept. F-24.

TRUSCON LABORATORIES
DETROIT • MICHIGAN

when we welded three ribs down the steel chute. It figures out that there is just as much pressure on the smaller surface of the ribs, but in practice the part slides down the ribs without any trouble, and that is just what we were after.

After installation of our conveyor system, one of those unforeseen changes came up. The part had to be turned around as it left the upper conveyor to slide down the chute onto the lower conveyor. We were in production and had to station two men with hand hooks at this point to turn the 600-lb. part around.

This was just that much more extra labor and expense, and besides, it made a terrible looking operation all the way through.

We wanted to be sure to have a smooth turning operation, and we accomplished this result by installing a bumper on the side of the conveyor. The part is retarded on the side that contacts this bumper, while the free end is driven forward until the part has turned through 90 degrees.

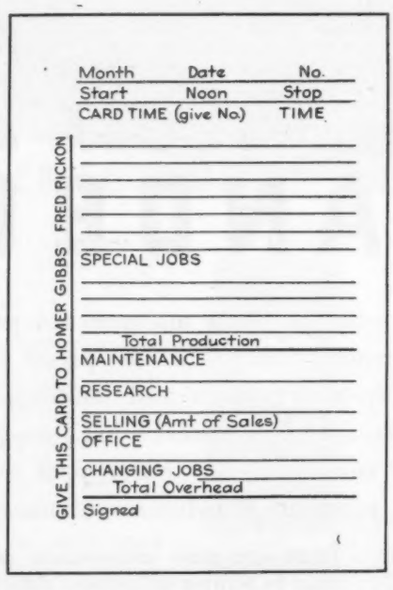
This bumper has taken place of the two men in turning the part, and the operation is smooth and reliable. Besides that, it has given us an efficient operation which has worked satisfactorily for over a year.

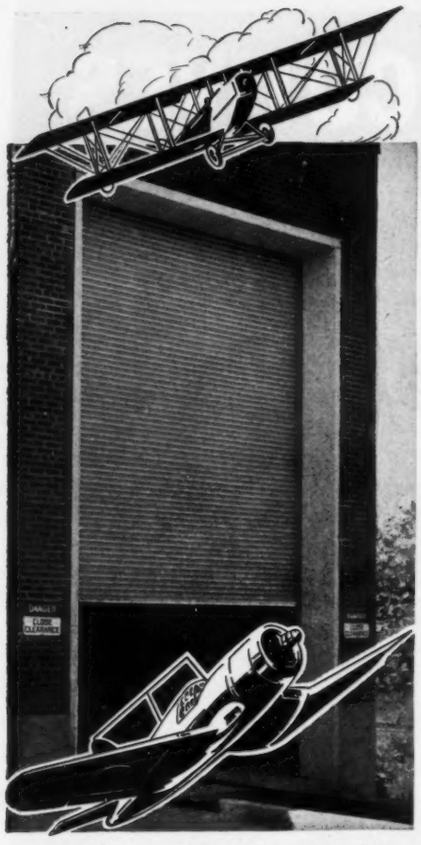
•

Employees Mark Their Own Time Cards

J. LYON, Lyon Rural Electric Company, San Diego, Calif.

One of our most successful time- and money-saving ideas is the use of independent time cards in our production department. Each employee keeps his own time and time clocks are not used. The foreman of each crew collects the time cards and turns them into the office. This system eliminates the need of a timekeeper and encourages employee cooperation.





STILL GOING UP

. . . Because the Principle is **RIGHT!**

Even in the days when airplanes *first* began to prove their efficiency, Kinnear Rolling Doors had "won their wings." Their principle of *coiling upward action* had long been proved. Supplemented by the interlocking steel slat curtain—*originated by Kinnear*—they afforded the most efficient door design ever developed. And they still do!

Kinnear Rolling Doors clear the entire opening with one quick, smooth, easy operation. They open completely out of the way, out of reach of damage! There are no overhead tracks to obstruct the use of conveyors, cranes, or similar equipment!

In fact, no other doors save more usable floor, wall, and ceiling space!

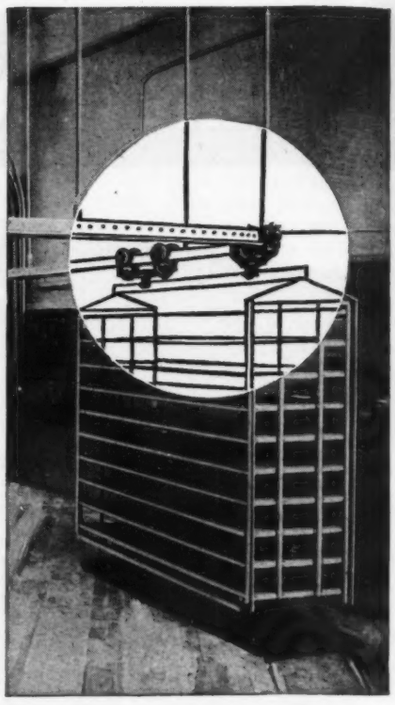
Kinnear Rolling Doors also combine rugged, all-steel *durability* with a degree of flexibility—they "absorb" many blows and impacts that damage ordinary doors.

They are built in any size, for old or new buildings, with motor or manual control. Write *today* for further information on money-saving, production boosting Kinnear Rolling Doors! The Kinnear Manufacturing Company, 1540-60 Fields Avenue, Columbus, Ohio.

Offices and Agents in Principal Cities

SAVING WAYS IN DOORWAYS

KINNEAR ROLLING DOORS



...WITH A BANG!

YES, collisions and confusion were a daily problem till this California bakery adopted Reading Monorails. No sort of traffic control had proven entirely satisfactory until the racks were hung on overhead tracks.

But then everything smoothed out like magic. No more bumps. No more spilled loaves of bread. No more mashed pies. Aisles were always clear of racks and free movement through the plant was facilitated.

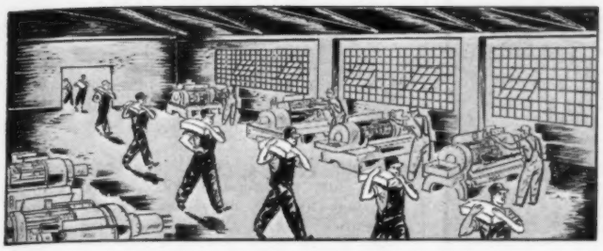
Expensive? Not at all. Hangers were simply welded to the old racks and old wheel assemblies removed. The only expense was this operation and the low-cost monorail equipment.

Is this an idea you might use? Why not see for yourself how little it would cost? Write us the details.

READING CHAIN & BLOCK CORP.
DEPT. 112 READING, PA.

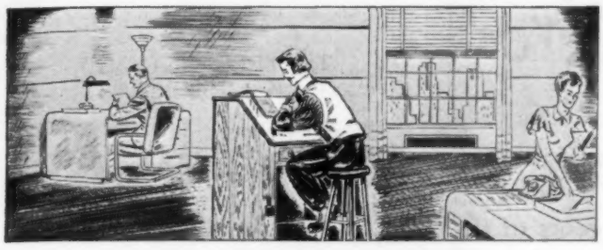
READING
Chain Hoists, Electric Hoists, Cranes and Monorails

You don't have to be modern...



You don't have to use conveyors

You don't have to use filing cabinets



You don't have to use adding machines

You could use ox-carts instead of trucks

and you can "get by" cleaning your plant by hand—*but consider the penalties*

1. Hand cleaning costs at least 5 times as much as vacuum cleaning. In one typical plant the cleaning cost per pound of dirt removed was 30c by hand and 4c after Invincible Industrial Vacuum Cleaners were put into use.

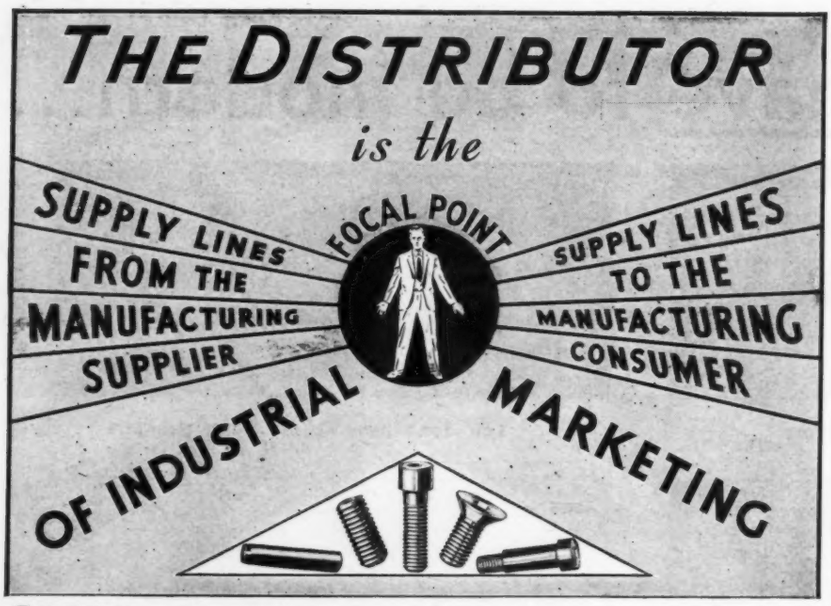
2. A high degree of plant cleanliness is the *very first* requirement for safety, health, employee morale, and low maintenance cost. But hand cleaning gets only a fraction of the daily dust and dirt. Invincibles get *all* the dust and dirt.

Invincibles clean any surface underfoot, overhead, or in between. They handle any kind of dust and dirt, and almost every kind of litter. Invincibles can be used profitably in practically *every type of plant.* Thousands of enthusiastic users, in scores of industries, give overwhelming evidence of this fact.

Without any obligation an experienced Invincible Engineer will gladly study your problem, demonstrate the advantages of this modern cleaning method, and show *you* how you can keep *your* plant cleaner at lower cost. Write to The Invincible Vacuum Cleaner Mfg. Company, 440 Davis Street, Dover, Ohio.

INVINCIBLE INDUSTRIAL VACUUM CLEANERS

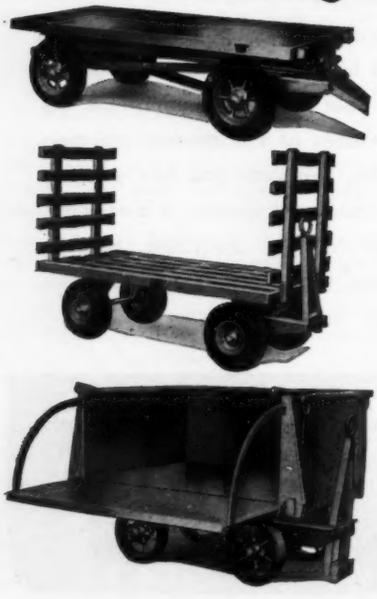
MORE THAN 15,000 IN USE FOR OVER TEN YEARS



ALLEN gratefully acknowledges the dependence of modern industry on a strong body of Distributors, serving as the sales agents of the manufacturer and the procurement agents of the consumer. Only through such an institution can supply and demand be adjusted to the *known needs* of producers — as only the local Distributor knows them.

THE ALLEN MANUFACTURING COMPANY
HARTFORD, CONNECTICUT, U. S. A.

EWC Hauling Engineers Solve Handling Needs



Today, one type of EWC Trailers is hauling hay to a stock yard, while another type is handling clay in the yards of a tile factory.

No matter what materials *you* handle, EWC Engineers can help reduce your handling costs and increase your handling efficiency!

The complete EWC Trailer Line—with its innumerable variations provides the proper hauling equipment for floor, yard, interplant, or street; in any capacity desired and with any type of body.

WRITE FOR BULLETINS, Prices, and Helpful Suggestions applying to your specific handling problems.

EWC TRAILERS
ELECTRIC WHEEL CO.
DEPT. FA QUINCY, ILL.

BOOKS

BELT CONVEYORS AND BELT ELEVATORS

Frederic V. Hetzel and Russell K. Albright. John Wiley & Sons, Inc., 440 Fourth Ave., New York. 439 pages. Photographs, tables, diagrams, charts, index. $6.

Third edition, revised and enlarged, of work first published in 1922. First part is devoted to belt conveyors, second to belt elevators. Both sections are intended as practical guides, to explain principles and reasons for doing things, rather than as descriptions of conveying and elevating machinery. What is new in present-day practice, what is obsolete and why, are fully explained in this edition.

THE PRESIDENTS AND CIVIL DISORDER

Bennett Milton Rich. The Brookings Institution, Washington, D. C. 235 pages. Bibliography, index. $2.

To enforce peace several presidents have made use of the armed forces of the country. Study shows how these presidents have handled major instances of domestic disorder.

•

ON THE CALENDAR

JANUARY

26–30, American Institute of Electrical Engineers, National Convention, New York. H. H. Henline, National Secretary, 33 West 39th St., New York.

26–30, American Society of Heating & Ventilating Engineers, 48th Annual Meeting, Philadelphia. A. V. Hutchinson, Secretary, 51 Madison Ave., New York.

FEBRUARY

4–6, American Management Association, Personnel Conference, Chicago. Frank F. Gilmore, Conference Planning Manager, 330 West 42nd St., New York.

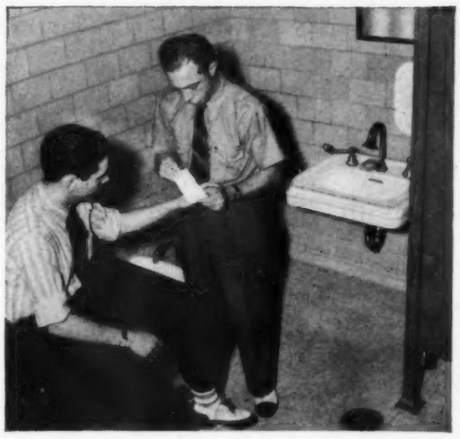
16–20, National Electrical Manufacturers Association, Chicago. R. J. Blais, Convention Manager, 155 East 44th St., New York.

MARCH

4, American Society for Testing Materials, Spring Meeting, Cleveland. R. E. Hess, Assistant Secretary, 260 South Broad St., Philadelphia.

4–5, American Management Association, Marketing Conference, New York. Frank F. Gilmore, Conference Planning Manager, 330 West 42nd St., New York.

CRANE PLUMBING AIDS *Wings for Defense* TOO!



Emergency Room at Taylorcraft plant designed to keep workers healthy and on the job.

AMERICA is on wings! Originally designed to make flying economical, aerial jeeps have enlisted in the Army and are now contributing to Uncle Sam's aerial might.

In the new Taylorcraft plant at Alliance, Ohio, more and more of these small airplanes are rolling off production lines. How well management at this plant recognized the importance of workers' well-being and comfort as an aid to production is indicated by the careful selection and installation of sanitary equipment throughout. Crane plumbing was chosen and is today contributing to the health, efficiency and satisfaction of Taylorcraft workmen.

Washroom at the Taylorcraft plant, Crane equipped throughout.

New plant of the Taylorcraft Aviation Corporation at Alliance, Ohio.

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PLUMBING • HEATING • PUMPS

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Made by the Makers of Armstrong Steam Traps

DO YOU KNOW the numerous benefits that can be secured by maintaining proper relative humidity in industrial plants during the winter heating season? "Prevention of loss of weight, strength, and quality of hygroscopic materials" . . . "Control of dust and static electricity" . . . "Improvement of workability of materials" are just a few of the improvements cited. Ask for a copy of our new bulletin telling "WHAT EVERY INDUSTRIAL EXECUTIVE SHOULD KNOW ABOUT HUMIDIFICATION."

TYPICAL RECOMMENDATIONS:

	TEMP. °F.	R.H. %
Paper Box Storage	60°-80°	45-60%
Shell Fuse Loading	70°	55%
Cotton Carding	75°-80°	50%
Rayon Spinning	70°	85%
Ceramic Molding Rooms	80°	60%
Meat Ripening	40°	80%
Testing Laboratories	60°-70°	60-70%
Printing Plants	75°	45-60%
Grain Storage	60°	30-45%
Leather Drying	150°	55-57%
Library Books	65°-70°	38-50%
Cigarette Making	70°-75°	55-65%

*For detailed recommendations and complete data, ask for Armstrong Bulletin No. 150.

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ARMSTRONG offers industrial humidifiers for as little as $100.00, list, for a unit complete with Friez humidistat, solenoid control valve, fan, steam strainer, drainage trap, and capacity to handle as much as 40,000 cu. ft. of space. Larger sizes are even more economical. All units are built for heavy duty industrial service and are sold on a "money-back" guarantee. Write for catalog.

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804 Maple St., Three Rivers, Mich.

THEY SAY AND DO

Army Volunteer Ban to Conserve Skills

The United States Army and Air Corps will close their rolls to volunteers and rely solely on Selective Service if current plans of Secretary of War Stimson are carried out. The major aim of this policy is to conserve the nation's supply of skilled labor.

Stimson pointed out that youthful war fervor was causing many men to leave their benches in defense plants for voluntary service in the Army. Under Selective Service, he said, those who were actually more important to the war effort if they remained at work could be turned back. No announcement of Navy policy on this question was made at the time of Stimson's statement.

In this, as in many other ways, the United States appears to be following the pattern of British economic and industrial policy as it plunged deeper into the realities of war control. In England recently E. C. Gordon, chairman of the Engineering Industries Association and managing director of the General Aircraft Company, placed before the nation an urgent proposal that the labor supply be rationed to vital industries.

"Somebody with all the facts before him must take the responsibility of saying that so many thousands of men must be in the coal mines, so many thousands in agriculture, and so forth, making allocations to munitions, transport, the armed forces, and the rest," he declared. "The country should be divided up and made to serve the nation as a whole. If there were such a design men could be gradually released for the armed forces as the munitions position developed and quantities were accumulated."

•

National Labor Survey Indicates Shortage

Despite priorities unemployment, decided shortages of labor are likely to occur in 1942, says the National Industrial Conference Board.

This prediction was placed on the record before America's entrance into the war. The greatly intensified tempo of war production will probably hasten the expected shortage by many months.

One of the most significant findings of the Conference Board survey is that the rate of increase in the total labor force has declined steadily since the middle of the last century, and the ratio of the total labor force to the population of working age has fallen steadily since 1910. The country's total labor force, consisting of persons gainfully employed (including those in the armed services) and persons seeking employment, is now about 55,000,000, some 400,000 more than a year ago, the Board finds.

"Most of the 1,500,000 men added to the armed services since June, 1940," the Board points out, "were already in the labor force, so that the number of civilians remaining in it is less than before the defense program began. The country therefore faces the largest production load in its history without the benefit of any increase in the civilian labor force."

At the time the survey was made, priorities unemployement was estimated at between 1,500,000 and 3,000,000. Even assuming that war controls may greatly increase this number, the war has also increased the probable total of the men in the armed services to 4,000,000 or even 5,000,000.

•

Full Cooperation in War Pledged by NAM

"Industry stands squarely behind the President and Congress in the fateful action taken today," read a telegram signed by Walter D. Fuller, president, and William P. Witherow, president-elect of the National Association of Manufacturers. The wire, sent to the President, the Vice-President, and the Speaker of the House on December 8, as soon as the Congress had voted to declare war on Japan, continued: "American lives have been lost in bombing; ships sunk; planes destroyed. These lives will be avenged through uninterrupted production on the factory front. The munitions of war can and will be replaced.

"Industry will build two battleships for every one that sinks.

"It will match every bomb with a dozen.

"It will blacken the skies with planes to replace the ones shot down.

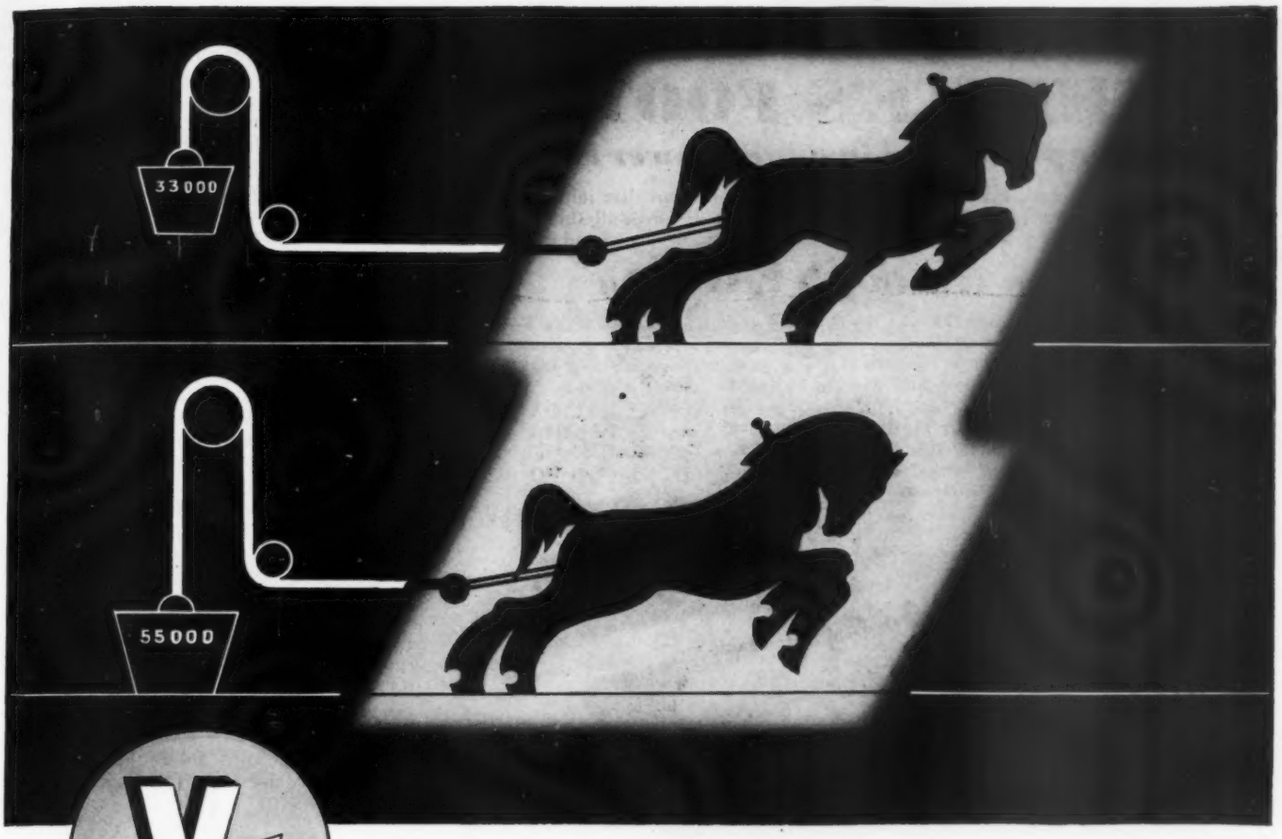
"Industry's production to arm our fighting forces will be limited only by the human endurance of the men who man and manage its facilities.

"We Americans have not always seen eye-to-eye among ourselves. But, as always, aggression from without fuses our family differences in unity of purpose. The enemies of our democratic way will find us one unbreakable phalanx in which class, creed, and petty politics are forgotten.

"With every other patriotic element in the country, industry is on the march. It will produce, produce, and produce to the end that victory shall be swift and sure."

This telegram followed on the heels of the annual NAM convention, and the 46th Congress of American Industry, held in New York December 3-5, at which the keynote had been "Industry's Place in a New World." Most of the speakers stressed what had already been accomplished for defense, with some optimistic predictions about the place American industry could take in the post-war world.

Delivering the keynote address, K. T. Keller, president, Chrysler Corporation, said: "Today's crisis in world relations is a challenge to our productive ability. The



MULTIPLE V-BELT DRIVE ASS'N

THE DOMINANT DRIVE OF INDUSTRY

TRADE MARK

The use of this emblem by an association member in connection with Multiple V-Belt Drives is your assurance of mechanical excellence — the result of cooperative engineering, research and experience.

how the "service factor" eliminates underguessing the required h. p.

During the early period of Multiple V-Belt Drive development it became apparent that somewhere in the selection formula, some important factor was missing. The belts on some installations wore out prematurely, although the drive theoretically satisfied all the mathematical requirements. In other cases where the specifications seemed identical, the drive delivered unusually long service. . . . Endless field surveys and the comparison of findings by members of the Multiple V-Belt Drive Association brought the "vagrant variable" to light. The difference lay in the characteristics of the prime mover and the nature of the load. It was discovered that some types of drives required up to double the number of belts for the same drive horsepower. . . . Results of thousands of check-ups, tabulated to include every conceivable combination, became today's "Service Factors". These "Service Factors" eliminate underguessing the required h.p. of the belts and assure long and uninterrupted service life.

MULTIPLE-V-BELT DRIVE ASSOCIATION
140 SOUTH DEARBORN STREET • CHICAGO

If you think
ATHLETE'S FOOT
can't be prevented in your shower rooms.

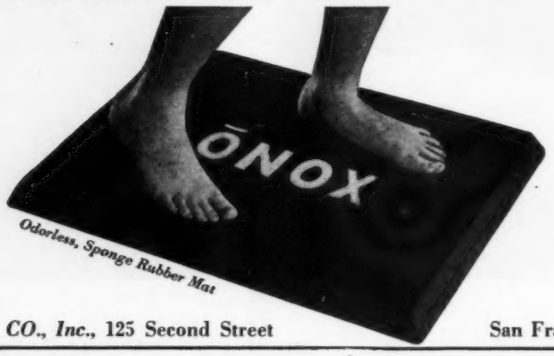
Maybe you have tried, hopelessly, to control this infection that impairs the efficiency of so many of your employees (see U.S. Public Health Bulletin E-572 B and R-674). Maybe you have tried every conceivable way to solve it and without result.

Then try the NEW *way*

Recent research has upset former theories on prevention of Athlete's Foot. The new procedure is revolutionary—the ONOX method. A safe non-poisonous skin toughener does the work. Employees like it! You may test it under any conditions you choose to impose and without obligation. For example:

- ***We will ship prepaid, your trial order for any amount of ONOX and equipment. Use it for 60 days. If at the end of that time ONOX has not proved itself to your complete satisfaction (100%) you owe us nothing and return nothing. This offer is open at any time to established industrials.***

We would like to send you the details of the simple ONOX method. Used by hundreds of industrials from Coast to Coast.



ŌNOX CO., Inc., 125 Second Street San Francisco

Do you know how to prepare for a foreman's job? how to get the promotion? how to succeed at the job?

JUST OUT!

Do You Want to Be a Foreman?

By Albert Walton

Associate Professor of Psychology
Pennsylvania State College

165 pages, 5½ x 8, $1.25

In just the way that he would talk to you face to face, Walton shows what it means to be a foreman, how to get a most valuable view, NOW, as a worker, of what you will face as a foreman, and how to start immediately to fit yourself for the responsibilities and duties of foremanship.

You may not know the answers to any of these questions, even the first one, now. *But you will after reading this new book.* For it gives you a series of plain, frank talks, by a *man who knows,* fixing in your mind, point by point, a completely guiding outline of foremanship purposes, requirements, and methods.

The Book:

—shows how to take stock of your strong and weak points, and lay out a program of self-improvement.
—shows how to get a head start in understanding the problems of managing workers and accepted methods of solving them
—makes clear the difference between the supervisor's viewpoint and the worker's viewpoint that clarifies many foremanship problems.

10 DAYS' FREE EXAMINATION—SEND THIS COUPON

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Send me Walton—Do You Want to be a Foreman for 10 days' examination on approval. In 10 days I will send $1.25, plus few cents postage, or return book postpaid. (We pay postage on orders accompanied by remittance.)

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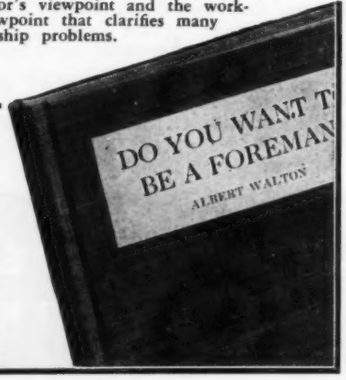


output of American industry will determine for many years to come the way of life of millions of people on every continent of the globe. . . We must outproduce a war machine abroad that is efficient and ruthless and which years ago made production for war its ultimate goal. Production and conquest, more production and more conquest—that is the formula behind the military march through Europe. However much we abhor their methods and detest their aims, we must realize that they have done and are doing a big production job. And we must top it."

He continued that under a system of free enterprise American industry had, in little more than a year, reached a production stage that took German industry, under a dictatorship, from three to five years to reach. "The present defense production program can be well handled by American industry. Over the years, thousands and thousands of minds in industry have been working on ways and means to do better jobs, to make better products that will meet the necessities and add to the comforts and conveniences of people. The result is that industry knows how to make things. . . Most important of all it has developed productive ability—management organizations, equipped with the knowledge of how production is accomplished and the ability to organize it, and the courage and initiative to pioneer new and better ways of doing things."

Asleep Standing Up

Not optimistic about the way industrialists are handling any situations outside the immediate province of their own daily operations was Thomas Roy Jones, president, American Type Founders. "We have been and are asleep standing up."

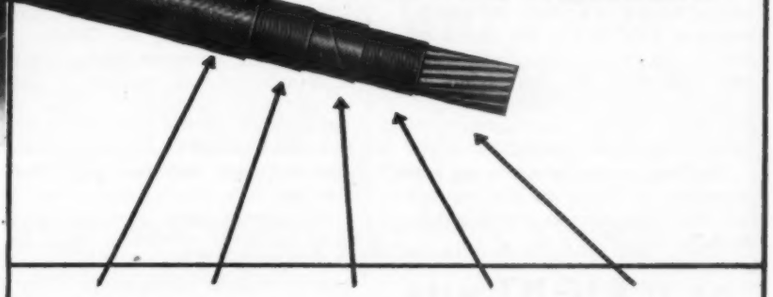
He criticized the method in which NAM tried to tell government agencies how to do their jobs. First they refer the matter to a committee, which draws up a set of resolutions, passes them, and hands them out to the newspapers. The press in turn, writes headlines that will be as sensational as possible, often emphasizing recommendations or demands that might better have been left out in the first place. He suggested that a better method would be to study the problem, meet with the government agencies, and try together to work out solutions.

Ignoring disagreeable facts is another frailty of the NAM, Mr. Jones argued. "We seem to believe that if we ignore a fact we won't have to deal with it, or it will just fold up and disappear so that it won't have to be considered. . . Here we are—a group of men whose every decision in the realms of our own businesses is based on the facts in the particular problem, but when we get together to treat of problems affecting national politics or economy we treat a fact as though it had leprosy." He then pleaded for realism in facing facts, for constructive thinking, and for cooperation in fighting for changes for the better.

Speaking on "Production," William S. Knudsen, director general of OPM reviewed briefly progress made during the past year and what could be looked for in 1942. Mentioning recent strikes, he said: "I can't for the life of me understand how in a period of national emer-

A Foot in time May Save Nine!

Here's What We Mean by Permanent Insulation



A tough asbestos braid finished with compounds resistant to heat, flame, moisture, fumes, grease, oil and solvents.

A dense felted-asbestos wall impregnated with heat, flame and moisture resistant compounds.

Layers of lubricated varnished cambric for high dielectric strength and permanent moisture resistance.

Another felted-asbestos wall to completely seal the varnished cambric from the harmful heat of overloads.

A perfectly centered conductor.

Rockbestos A. V. C. (Underwriters' and N. E. Code Type AVA). Power and Motor Lead Cables have these insulation qualities.

Like everything else, wire is on that endless list of materials hard to get. And that means that any wire failure that makes rewiring necessary is a two-fisted punch on the nose!

Here's a sound suggestion. Go over your lighting, power and control circuits and pick out the spots where wire commonly fails—the hot spots; places where oil, grease, fumes and moisture make trouble; tunnels where wire is run near steam lines; around boilers, furnaces and other heat generators—then give us your minimum footage requirements and preference rating and we'll supply *permanently insulated* Rockbestos just as fast as we can.

A few feet of Rockbestos here and there may save repeated replacements because it is heat-proof, fireproof and resistant to moisture, oil, grease, corrosive fumes and solvents. It won't fail under the toughest going, eliminates production tie-ups, saves time, trouble and money.

118 standard, permanently insulated Rockbestos wires, cables and cords to select from. Anticipate your requirements and send for a catalog.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

ROCKBESTOS PRODUCTS CORPORATION, 828 NICOLL STREET, NEW HAVEN, CONN.

To the non-technical buyer, one make of Fluorescent equipment may look so much like the others that he can only *guess* which is the RIGHT one to choose. As a result, many an inferior fixture has been selected just because it "cost a little less."

But gradually, as utilities and architects spread the facts, more and more business men realized that the *real bargain* in Fluorescent lighting is the BEST ENGINEERED JOB. That is why so many leading firms are now insisting on LINOLITE—the equipment that is *Engineered for Performance* and *Guaranteed for Satisfaction* by FRINK, pioneers in Fluorescent lighting and leading manufacturers of lighting equipment since 1857.

Mail the coupon below for our new brochure of Frink installations and valuable Fluorescent engineering data. It shows why it pays to

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Please send me your new brochure on "The Ultimate in Fluorescent Lighting."

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gency such foolishness can go on. . . I have up to now supported the contention that laws were not needed to get top production in the United States, but I am quite frank to confess that with our house on fire, we can't have a strike in the fire department and refer it to conciliation."

•

Pickets Picketed by Coast Workers

Workers in a Los Angeles plant turned the tables on a group of AFL pickets recently in a manner that bespoke the psychological change wrought by America's entry into the war.

The pickets were encamped at the gates of the V-O Milling Company. Their automobile carried a large sign denouncing the company as "unfair." During the noon hour the employees put larger signs on either side of the AFL sign. These read:

"Work or fight, you slackers."

"Real Americans are on the job."

"Guns, planes, food cannot be produced on the picket line."

"America is at war. To obstruct the flow of civilian and defense production helps Hitler and the Japs."

•

Training-Within-Industry Intensifies Program

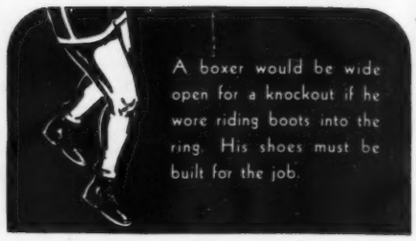
One of the best-established agencies of the defense administration, OPM's Training-Within-Industry Branch, has moved further into the foreground as a result of the war.

With a small staff in Washington, headed by Channing R. Dooley, TWI maintains an extensive field organization to furnish practical assistance to industry in on-the-job training. It also advises managements on the best ways of availing themselves of the many other government agencies which deal with other forms of training.

Experienced men, borrowed part-time from industrial companies, head up the local staffs of TWI. All are volunteers, working without compensation. From their knowledge of the national program plus their acquaintance with local conditions they are able to assist defense manufacturers by helping them to analyze their training needs, by helping them to set up training programs, by making available to them the lessons learned from the experiences of other companies, and by explaining to them the services of the vocational and trade schools, the local engineering defense programs, the public employment agencies, the N.Y.A., CCC, WPA, and the like.

The 21 district TWI supervisors are assisted by full-time staffs. The district offices are located in:

Atlanta, Georgia School of Technology, 225 North Avenue, NW; Baltimore, Room 3106 Baltimore Trust Building; Boston, Room 1033 Park Square Building; Chicago, Room 1441, 20 North Wacker Drive; Cincinnati, Room 802 Fifth-Third Union Trust Building; Cleveland, Room 797 Union Commerce Building; Denver,



Casters, too, must be built for the job

AVOID snarls in materials handling! Put *built-for-the-job* Bond Truck Casters on all your trucks. These carefully designed casters *take the punishment . . . take the loads . . . take the turns.* The Bond 136-A (illustrated) features especially designed double ball races to promote smooth rolling and absorb shock. For guidance in fitting your casters to the job, write today for your free copy of the Bond Data Book.

Bond Lift Jacks and Platforms offer built-for-the-job advantages, too. Write for bulletin.

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Bond
REG. U.S. PAT. OFF.
TRUCK CASTERS

"ON-THE-SPOT" CHARGING

OF ELECTRIC TRUCK BATTERIES

Pays Big Dividends

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Savings possible in POWER . . . TIME . . . LABOR with the new G-E Copper-Oxide Battery Charger for Electric Truck Batteries are astounding. Fast . . . efficient . . . decentralized, "on the spot" charging makes such savings possible.

G-E TUNGAR CHARGER

For use with small electric trucks equipped with 6-volt or 12-volt lead batteries. Initial charging rate of 40 amperes automatically tapers to 16 amperes and at termination of charge automatically cuts off. Furnished complete with long A-c. and D-c. leads and two 99X45 Tungar Bulbs.

REASONS WHY

1. **FLEXIBILITY:** Can be easily installed anywhere in the operating territory of the truck . . . is readily transferred to another point when occasion requires.
2. **AUTOMATIC OPERATION:** Initial high-charging rate automatically reduces to safe finishing rate . . . cuts off automatically on termination of charge.
3. **RUGGED CONSTRUCTION:** All parts enclosed in a substantial steel casing . . . maintenance reduced to a minimum due to elimination of moving parts.
4. **ECONOMICAL:** Saves time, labor and power ordinarily lost in going to and from a central charging station.

FOR MORE INFORMATION SEND THIS COUPON

Section A-2831, Appliance & Merchandise Dept.,
General Electric Co., Bridgeport, Conn.
Sirs: Please send more information on G-E Chargers for Electric Truck Batteries.

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GENERAL ELECTRIC

Need Pressure Regulating Valves?

Hannifin Air Pressure Regulating Valves are carried in stock for immediate shipment (standard sizes—⅜, ½, and ¾ inch)

This simple and dependable piston-type valve provides the reliable, accurate control of operating pressures needed for efficient operation of arbor presses, riveters, air chucks, cylinders and other pneumatic equipment. Piston type design gives sensitive control and large volumetric capacity in a simple valve built for long life without maintenance. Operating pressure is easily adjusted over the entire range merely by turning the adjusting screw. The wide range of adjustment makes this valve applicable to a great variety of service requirements.

Order these valves for your stock now and have them on hand when you need them.

Three standard sizes available, ⅜, ½, and ¾ inch, for use on initial pressures up to 150 lbs. Furnished complete with pressure gauge.

Write for Bulletin 56-F with complete description.

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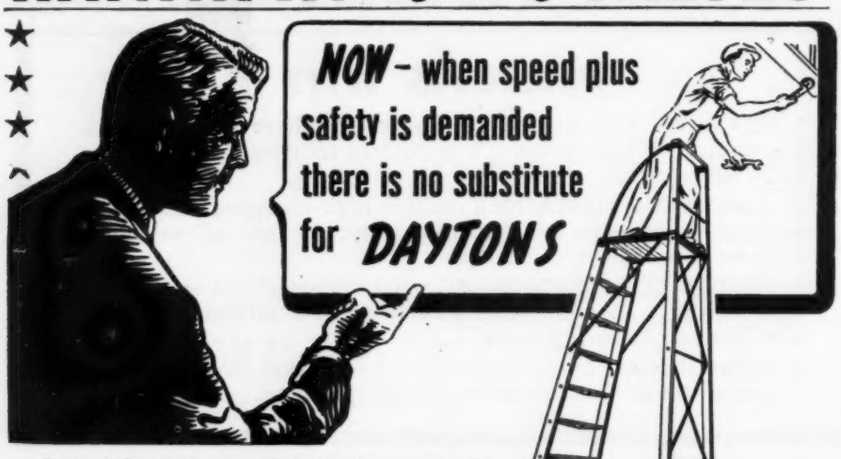
ENGINEERS • DESIGNERS • MANUFACTURERS • DOUBLE-ACTING PNEUMATIC AND HYDRAULIC CYLINDERS • ALL SIZES

HANNIFIN *pressure regulating* VALVES



Dayton Safety Ladders are eliminating the expensive delays caused by the hazards of ordinary ladders. Men work faster, with more confidence, on the broad, firm platforms of Daytons. Ample room for tools and supplies. Rigid steel supports, tested airplane spruce give the Dayton Safety Ladders great strength, stability, and extreme lightness of weight. Standard Rubber Safety Shoes at no extra cost.

WRITE TODAY FOR PRICES AND FREE CATALOG.

The
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Install these safety shoes on your present straight ladders. They guarantee additional safety. This Dayton Universal Safety Shoe prevents ladder slipping. Your choice of renewable treads including Rubber Suction Grip Treads or Suberac Cork Treads. Shoe is instantly converted by a flip of the hand or foot for either inside use of treads or outdoor use of tempered steel spike toes.

The **DAYTON Safety Ladder Co.**

121-123 W. Third St. Cincinnati Ohio

As Safe as Standing on the Floor

Room 518 U. S. National Bank Building, Detroit, Room 702 American Radiator Building; Houston, Texas, Room 3201 Gulf Building; Indianapolis, Room 915 Circle Tower Building; Los Angeles, Room 452 Roosevelt Building; Minneapolis, Room 1800, Rand Tower Building; Newark, Room 601, 605 Broad Street; New Haven, Room 513, 152 Temple Street; Philadelphia, Room 2301, 12 South Twelfth Street; Pittsburgh, Room 360, Administration Building, Carnegie Institute of Technology; Raleigh, N. C., Raleigh Building; St. Louis, 603 Shell Building; San Francisco, Room 702, 260 California Street; Seattle, Room 957 Stuart Building. The Seattle office has an affiliated branch in Portland Oregon, Room 1100 Public Service Building.

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Training Films Released By U. S. Agency

"Textbooks in celluloid" to speed the training of workers in war industries are being produced by the United States Office of Education.

The first 18 of what will eventually be a complete series of 50 reels of film have already been released. Forty films in the series witll give detailed instruction in machine shop practice. Seven reels are devoted to the engine lathe, five reels cover precision measurement, five are on the vertical boring mill, five on the milling machine, five on the use of the drill presses, seven on bench work, three on the shaper, two on the action of single-point cutting tools, and one on layout.

The thoroughness with which these subjects are covered is typified by the seven-reel treatment of engine lathe work which shows rough turning between centers, turning work of two diameters, cutting a taper with the compound rest and with the taper attachment, drilling, boring, and reaming work held in chuck, and cutting an external national fine thread.

These films will be reproduced in 16-mm. size and made available at low cost to defense training centers, vocational schools, and industries offering apprentice training.

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$200,000 Prize Awards Offered by Foundation

Entries are now being received for the $200,000 Industrial Progress Award Program for papers on arc welding. The contest is sponsored by the James F. Lincoln Arc Welding Foundation. This well-established competition is open to engineers, draftsmen, consultants, architects, garage men, and industrial employees.

Four hundred and fifty eight awards totaling $200,000 and including a grand award of $13,700 are offered. There are 12 classifications including automotive, aircraft, railroad, watercraft, structural, furniture and fixtures, commercial welding, containers, functional machinery, industry machinery, and maintenance.

Papers mailed up to midnight, June 1, 1941 will be accepted. For details write the James F. Lincoln Arc Welding Foundation, Box 5728, Cleveland, Ohio.